

Popular Science

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June
1927
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In This Issue

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WHAT IS NEW THIS MONTH

Table of Contents for June

LEADING ARTICLES

TELEVISION AT LAST! By Edgar C. Wheeler	11
An explanation of the first successful system for sight at a distance.	
CAR MAKES 207 MILES AN HOUR By H. C. Davis	20
Details of the wonder racer that smashed the world's record.	
NEW PLANE STOPS LIKE AN AUTO	23
Navy's latest fighting craft, a marvel of control.	
POPULATIONS PREDICTED FROM A STUDY OF FLIES	24
An informative article on an unusual line of scientific research. By Myron M. Stenius	
FORTY-NINERS OF 1927 By Edwin Ketchum	27
A thrilling story of the recent Nevada gold rush.	
AN AMAZING VISION OF THE FUTURE By Robert E. Martin	29
Have you wondered what life will be like a hundred years from now?	
HOW SEA FLYING WAS MADE SAFE By Frank Parker Stockbridge	32
Triumphs of Glean Curtiss, air pioneer.	
FACTS EVERYONE SHOULD KNOW	34
Fifty-eight questions to test your stock of useful information.	
IS THERE A HUMAN SPEED LIMIT? By Arthur Graham	35
New discoveries about the mechanics and chemistry of athletics.	
A WONDERLAND OF SCIENCE By Alden P. Armagnac	43
How the Popular Science Institute of Standards conducts its tests	
SAM LOYD'S PUZZLE PAGE	67
WHAT IT COSTS TO BUILD By John R. McMahon	68
Facts and figures that will help you when you construct your home.	
HOW TO SAVE MONEY ON TIRES By Martin Dunn	71
Gus and Joe point out some new kinks.	
A FOUR SQUARE FINANCIAL PLAN FOR A YOUNG MARRIED COUPLE	6
By Wallace Ames	
WHAT THOUSANDS DID WHO WERE BUYING RADIO, TOOLS AND OIL	8
BUENOS AIRES	

FICTION

BLACK DEATH By Fitzhugh Green	10
A Naval officer's vivid story of life in a submarine.	
BAKE HANDS—PART 4 By Hawthorne Daniel	40
A novel of science and adventure in the Far North.	

RADIO

WHY CAN'T I GET DISTANCE? By John Carr	63
A COMPACT RADIO SET By John E. Lodge	66

THE HOME WORKSHOP

HOW TO BUILD A CANVAS CAMP By Henry S. Lorchy	73
A TABLE FOR YOUR BENCH LATHE By Colin L. Blair	76
A JOB TOO BIG FOR A LATHE By James Ellis	82

Astronomy

Sun's Next Eclipse on June 29	37
Another New Comet Discovered	51
Comet to Whiz Near on June 26	55
How the Moon Affects Quakes	47
Songpo's Cause of Wars?	50

Automobiles

Gearless Car is Run by Liquid Turbine	14
New Sliding Seat for Closed Cars	49
A Gas Tank Cover You Can't Lose	40
A New Battery Tester	40
Sand Box Like Locomotive's Prevents Skidding	48
Odd "Feet" Serve as Jacks or Mudhooks	48
New Clamp for Radiator Hose	49
Ingenious Towline Can't Drag on Ground	48
Protects Your Fenders from Grease	49
Know Your Car	50
Would Make Nocturnal Pedestrians Carry Lights	58
Paris Trees Portable Semaphores	50
Spare Tire Helps Jack Up Car	70
Saving Your Springs	70
Old Run as Hose Rack	70
Simple Battery Handle	70
Turnbuckle Compresses Rim	70
To Close Piston Rings	70
Air Moistener	70
"What Was Wrong with Markin's Car?"	71

Aviation

Strange Electric Tube in Airplane Beacon	14
Self-Starter for Airplane Motors	14
Amazing Dirigible Has No Propeller	30
World's Largest Land Lighthouse Guides Flyers	30
Trans-Atlantic Plane Has Novel Features	30
Latest German Super-Airship	31
New "Relbreathing" Apparatus Tests Air Pilots	31
Torpedo Planes in Action	31
New American Airplane Carrier	31
An Air Fleet Goes to War	47
A 10,000-Watt Sun for Airplane Landings	48
New Giant Dirigibles	54
Latest British Airplane Catapult	58
Plane Carries 110 Passengers	50
Flier's Chief Requisite—Nerve	50

Exceptional People

Wisconsin's Champion Whittler	50
Violin Maker's Jackknife Art	51
12 Years Old Runs Radio Station	51

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*In This Single Issue We Publish More Than 250 Articles
Depicting the Latest Achievements and Discoveries
in the World of Science and Invention*

Explorations

Explores Natural Bridge in Sling	14
Relics of Ice Age Americans	28
Pygmy Hunter Back with Trophies	31
Navy Mapping Southern Seas	34
World's Oldest Book at Last Deciphered	62

Health and Hygiene

New Anesthetic Tested	28
Blood Has Daily Tide	38
Alcoholic Hats and Heredity	39
Hearibed Lake Canyon's Boom	51
New Invalid's Chair Propelled by Motor	52
Hormone Makes Hearts Beat	53
How Cool Should a Theater Be?	53
Do You Know Your Body Area?	53
New Earphone Aids Deaf	56
Exercising on Half a Bicycle	57
Epidemic Mild or Severe	58

Hints for the Mechanic

Quick Way to Draw Screw Threads	100
Using a Shaper to Cut Internal Key Seals	110
Assembling Pipe Wrench with Aid of Paper Wax	111
A "Keeper" for Numbering Sets	112
Controlling a Searchlight from Motorboat Cabin	112
Small Soldering and Glue Kit	113
V-Rest on Micrometer Holds Small Work	114
Welded Steel Bracket Replaces Casting	115
Tool Removes Oil Head Keys	115
Auxiliary Support for Work Held in Vice	116
Bending Tongue and Spring Clamps for Tin Shop	116
Centering Key-Slot Cutters	116
Cutting Pulley Oil Grooves	116
Simple Center Gage for Drill Points	117
Compensating Blocks for Vice	118
Cleaning Device for Shaft	118
Redwood for Ship Models	118

Ideas for the Handy Man

A New Way to Hide Wallboard Joints	77
Turning Wooden Segments	77
The Latest in Block Paving	78
New Fishing Bods for Old	80
How to Replace an Old Electric Light Bracket with a Sensor	81
A Circular Saw Attachment for Your Tool Grinder	86
How to Hold a Spokeshave Blade for Sharpening	87
How to Refinish Your Floors	88
Neat Bookcase Joints	89
Builds Wavelike Stand for Galleon Model	91
Rubber Band Tractor is Amusing Toy	91
Clamps for Wood Turning Lathe Save Skipping	95
Painters use Brushing Lacquers	91

"Dustless" Door Mat	97
You Can Build a Viking Ship	98
Toy "Sub" Dives and Rises	100
Blueprints for Your Home Workshop	101
How to Repair Amber Rim Eye Glasses	102
Free-Sawed Plant Sticks	103
Easily Made Baseball Game for Young Children	103
Boy's Play Arbor	104
How to Purify Shellac	105
Wooden Monkey Performs Balancing Stunts	107
Applying Lacquer to Metal	107
A Ball Bearing Merry-Go-Round	108
Footstool like Old Treasure Chest	108
Making Wooden Joints Watertight	109
Child's Desk Built into a Chair	120
Parrot Feathers Decorate Unique Sewing Tray	120
Wall Cabinet with Shaving Shelf	124
Your Home Workshop Problems Solved by Experts	128
Transferring Pictures on Glass and Porcelain	129

Laboratory Discoveries

Invents Amazing Electric Relay	20
Will New Tests Solve Shennandoah Mystery?	38
Science "Hears" the Atom	39
Science Weighs a Mountain	46
New Element Isolated	40
Amazing Electric Instrument Measures Tiny Current	55
Bees Stupid, Scientist Finds	54
Invisible Rays Solve Crime	58
Measures Huge Volcanic Heat	58

New Processes and Inventions

Vacuum Cleaner for Railway Tracks	13
New Yacht Built Like Zeppelin	15
Searchlight Gun "Shoots" Pictures on Clouds	15
Longest Power Transmission Near "Mercury Bullets" Stan, Not Kill	26
Radon Tells the Time	39
Aluminum Made from Clay	47
Device Takes Telephone Message	47
Wood Made from Pine Needles	47
Now—Ball-Bearing Trains	48
You'll Soon Be Proceeding This Way	48
Canadian Police Signal System	50
New Steel Belies Nicks	51
Pre-Cast Rings Build Stacks	52
Waterproof Dress Forestalls Sudden Showers	52
New Indoor Golf Game Like Billiards	52
New Fuel Made from Ashes and Shavings	52
Duplicated Criminal's Fingerprints	53
Repeating Phonograph Plays for Hour	53
Novel Cigarette Case Carries Matches	53
Lantern Built into Handy Case	53
New House Put Together with Wrenches	53

Color Photo Has 8,000 Lamps	34
Propeller Fins Speed Up Ships	35
Mechanical Washer Cleans Golf Balls	39
Novel Typesetting Machine	50
New Compact Metal Rule	56
Device Checks Goller's Swing	56
Free-Bottom Boat Needs No Channel	57
Fireman's Safety Lamp Runs on Flashlight Batteries	57
New Overalls Have No Buttons	57
Loudspeaker Replaces Inter-Office Phone	57
Washing a Train by Machine	58
Gasoline from Lignite Achieved	58

New Devices for the Home

Electric Servant Whips Cream, Beats Eggs	60
Novel Can Opener	60
Compact Clothes Rack	60
Mixer Pie Crust	60
New Cigar Lighter	60
Makes Your Tub a Shower Bath	60
New Dishwasher Makes Own Soda	60
Handy Electric Hot-Plate	60
Beats Eggs by Water Power	61
Ironing Board in Kitchen Table	61
Magic Silver Cleaner	61
Milk Bottle Cap Pours	61
Hand Dishwasher Has Spinning Electric Brush	61
Two Can Openers in One	61
Electricity Keeps Your Air Moist	61
New Home Ice Machine	61
Curved Heavy-Duty Kitchen Shears	61

Photography

Gets \$1,000,000 for Photo Invention	16
Automatic Aerial Camera Almost Human	36
Novel Camera Aids Sculptor	57

Radio

More Antennas, Weaker Signals	30
Quartz Motor Run by Radio	34
Magnetized Area Fine for Radio	39
Radio Set for Aviators	39
Solving the "C" Battery Problem	64
Don't Burn Wiring	64
How to Stop "Motorboating"	64
Light for Your Dials	64
Wire Skinning Pliers	65
Try This to Improve Tone	65
To Increase Selectivity	65
Cutting Out Electrical Interference	65

Unusual Facts and Ideas

New Speedboat Record	14
Blowing Up a Roomboat	15
Great Hudson Tunnel Underpans Health Tests	37
No "Criminal Type," Survey Shows	58

Continued on
Page 143

HEAR ELECTRONS JUMP!

Do electrons jump? We talk about quadrillions of them per second leaping across from the filament of the plate of a Radiotron, when you are listening to a lecture. But these particles are so tiny that no microscope could make them visible—not even a thousand of them clustered together!

They cannot be seen. But in one of the Radiotron laboratories there is an interesting device with which they can be heard. A delicate amplifying system and a loudspeaker do for the ear what the microscope cannot do for the eye—they reveal the actual existence of the electron. You hear it hit the chamber.

This device is but one of many fascinating machines built in the laboratories of "pure science" where research carries forward our knowledge of the vacuum tube and its action. When you buy an RCA Radiotron, you have the benefit of this research, in the fine performance of the tube in your set.

There is a Radiotron for every purpose. Look for the RCA mark to be sure it is genuine.



RADIO CORPORATION
OF AMERICA
New York Chicago
San Francisco



The new radio is clearer try this improvement on your old set

Most people want radio music loud enough to fill a room. But on many sets, this volume of tone cannot get through the last audio stage without getting badly distorted. But you don't hear this blurred music so much today.

Since RCA developed the power Radiotrons, they've been adapted into new sets. Make the same change in your old set. Let the big volume through clear and true-toned—without distortion. Put in one power Radiotron in the last stage, and clear up the tone!

Bring your storage battery set up-to-date with
a power RADIOTRON UX-171 or UX-812
a detector RADIOTRON UX-200-A
and RADIOTRONS UX-201-A for all-round quality.
Bring your dry battery set up-to-date with
a power RADIOTRON UX-120
and RADIOTRONS UX-199 for all-round quality.

RCA Radiotron

MADE BY THE MAKERS OF THE RADIOLA

The first picture of that "knock"



This is the "knock" in your motor

This shows photographically what occurs in the engine cylinder as carbon forms, when straight gasoline is used. The increased heat and pressure created by the carbon cause the gasoline to explode too quickly, with the result that there is an accumulation of high pressure heat waves which strike against the cylinder walls so violently as to produce an audible metallic sound. The bumps in the line are that "knock."

This is how "ETHYL" knocks it out

And this shows photographically what goes on in the same cylinder under the same conditions when straight gasoline is treated with "ETHYL" fluid. Note the absence of "knock-bumps"; the evenness of the pressure changes. The "ETHYL" fluid has neutralized the heating qualities of the carbon deposits and by maintaining the normal combustion rate of gasoline has turned the increased pressure due to carbon into increased power.



THESE PHOTOGRAPHS were made possible by a special instrument invented by General Motors Research Laboratories to find out what goes on in an automobile engine's cylinder when "knocking" occurs.

That invention led to the discovery that what you may call an "engine knock" or a "spark knock" is in reality a *fuel knock*. It is due to the tendency of a straight gasoline to explode too quickly as carbon forms and increases temperature and compression (pressure).

Having determined the character of "knocking," General Motors developed "ETHYL" fluid, a patented chemical compound which when added in very small

quantities to straight gasoline forms Ethyl Gasoline, the most effective "anti-knock" fuel yet known.

Ethyl Gasoline transforms carbon deposits from a liability into an asset. It produces more power on hills and heavy roads. It gives a faster "pick-up," reduces gear-shifting, lessens vibration and engine wear and tear; and saves the trouble and expense of carbon removal.

Ethyl Gasoline has increased the motoring satisfaction of hundreds of thousands of car drivers. It is destined to play a still more important part in the automobile history of the future. TRY IT.

ETHYL GASOLINE CORPORATION
25 Broadway, New York

ETHYL GASOLINE is now generally available throughout the United States and Canada through the following oil companies, licensed to mix "ETHYL" fluid with gasoline. The "ETHYL" trademark on the pump is your protection.

• • •

Associated Oil Company • Atlantic Refining Co. • Beacon Oil Company • Continental Oil Company • Humble Oil & Refining Co. • Imperial Oil Limited (Canada) • Penzoil Company • Refiners Oil Company • Spears & Riddle Co. • Spokane Oil & Refining Co. • Standard Oil Company (Indiana) • Standard Oil Company (Kentucky) • Standard Oil Company of Louisiana • Standard Oil Co. (Neb.) • Standard Oil Company (N. J.) • Sterling Oil Company • Union Oil Company of California • Waltham Petroleum Co. • Waverly Oil Works

ETHYL GASOLINE



A Four Square FINANCIAL PLAN for a YOUNG MARRIED COUPLE

By WALLACE AMES, *Financial Editor*

THE Financial Department's mail at the POPULAR SCIENCE MONTHLY office contains many letters relating to interesting financial plans and problems such as everyone confronts. We are yielding to the temptation to publish one of these letters together with our reply as we believe the subject will stimulate the thoughts of every reader who is seeking a sound program for his personal finances.

Because of the personal nature of the following letter the identity of the writer has been purposely deleted.

Mr. Wallace Ames,
Financial Editor,
POPULAR SCIENCE MONTHLY,
New York City.

Dear Mr. Ames,

My wife and I would appreciate your advice and suggestions in our financial situation. In order that you may be familiar with our case it is necessary to give you some personal facts.

I am thirty-two years old and have been married three years. Until now my salary has been \$6,000 a year, but I have just been advanced to a higher position at a salary of \$8,000 with an opportunity of an annual bonus of \$500 to \$1,000.

In the past, both before and since I was married I notice that soon after every increase in income my expenses grew up to it so that to date I have not accomplished much of anything towards future financial independence.

We have been getting along comfortably on \$6,000 and my wife and I are very anxious to make this new increase in income be the beginning of real worthwhile financial progress.

THUS far we have laid by \$1,000 and I am carrying \$10,000 life insurance. Without stinting we can save and invest \$2,000 to \$2,500 a year from now on. If not asking too much, would you be good enough to write me suggesting the plan or program that you think a young married couple should follow under the circumstances I have outlined.

Here is Mr. Ames' reply to the above letter:

It is a pleasure to assist you in the formation of a sound getting ahead program. Judging by the information

contained in your letter you are ideally situated to carry out what we term the Four-Square Financial Plan.

The four parts of this plan are the following:

1. Adequate savings bank balance for emergencies;
2. Adequate life insurance protection;
3. Home ownership;
4. Sound securities for independent income.

A Service for Readers

THIS Financial Department is to help readers in the establishment of proper financial programs at the beginning of their business careers; it assists those who have accumulated money in the proper investment of it.

The Editor of this Department is an authority on investment matters. He is ready to aid in personal investment problems. Advice will be gladly given regarding the proper investment of funds and proper plans of saving.

Address your inquiries to Wallace Ames, Financial Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York. While investments obviously cannot be guaranteed by the Publisher, every effort will be made to insure that only advertisements of absolutely reliable companies are accepted.

In the first place we suggest that you leave the \$1,000 you now have in the savings bank where it will draw 4% compound interest. This will give you available cash for any ordinary emergency or special purpose.

Next in logical order is life insurance. Your present insurance line, amounting to \$10,000 would at 5% yield your wife an annual income of \$500. This is not adequate. If you increase your insurance to \$50,000 your wife would have an income (at 5%) of \$2,500 in the event of your death. While this sum is less than each of you now spend to live we would consider it adequate protection.

At age 32 ordinary life insurance costs about \$16.25 a thousand (dividends deducted) or \$650 a year for

\$40,000 additional insurance. We believe you would find it convenient to take out several policies so arranged that you could pay about \$54 each month in premiums instead of having larger sums come due less often.

After paying insurance premiums you have approximately \$1,800 a year for investment. Of course you should anticipate owning your home. If you plan on one valued at \$15,000 to \$18,000 it would require a cash investment of say \$9,000 in addition to the mortgage. With this in view invest \$150 a month for five years in securities maturing in five years. You should then have, including interest earned, about \$10,000 to \$10,500. This finances your home purchase and leaves a starter for a long-term security buying program.

THE fourth step in your four-square financial program is to acquire sound securities for permanent independent income. For this purpose you simply continue to invest \$1,800 annually (\$150 a month) the same as you first did to buy your home. If you devote the first five years to home buying there remain thirteen years before you are fifty. Let us see what you can accumulate by that time.

According to the table published in the booklet of one investment banker \$150 a month invested in their 6½% bonds builds a total worth of \$36,595 in thirteen years, of which sum \$13,195 is interest. Another bond house publishes a table of results of systematic investing which shows that \$150 a month invested in bonds yielding an average of 6% will amount to \$43,567 in fifteen years. (The figures in this table are in five-year periods only so we cannot ascertain the exact accumulation in thirteen years.)

Of course it is impractical to estimate down to the dollar how much you may accumulate over a period of years. But it is safe to approximate that in thirteen years, or by the time you reach fifty years of age, you may own \$36,000 to \$37,000 of bonds.

On the basis of the general plan outlined we would estimate your financial worth at fifty years of age as follows:

Equity in home.....	\$ 9,000
Securities owned.....	36,000
Cash value of \$50,000 life insurance.....	13,000

Retire in 15 years

on your Present living Budget

Follow the definite plan given in this book, and your financial independence is won.

The plan works just as surely, whether you are now earning \$1,000 or \$100,000 a year.

The way is certain—each step plainly indicated and absolutely safe—dependent of luck, business genius or speculation.

Every fact has been harvested out of the 46 years' experience of Cochran & McCluer in the first mortgage investment banking business.

The plan is so simple, anyone can understand it—so definite anyone can follow it—and so certain, no one can fail.

In addition to the Financial Independence Plan and the unique budget schedule, the book gives suggestions that enable you to enjoy more of the good things of life, both while building your independent fortune and after you have attained it.

We invite the most skeptical to read this plain, straightforward, interesting book.

Phone, call or send coupon. We employ no salesmen, therefore none will call.

Mail this

Cochran & McCluer Co.
46 N. Dearborn St., Chicago, Ill.
Please send me, without obligation, your book, "Behind The House Where Bonds Are Made."

Name.....
Street.....
City..... State.....

Cochran & McCluer Co.
46 North Dearborn Street
1109 Bryn Mawr Ave. 4613 N. Lincoln

Construction of Small Alternating Current Motors

By PROF. A. E. WATSON
Brown University

This book contains complete instructions for building small alternating current motors in several sizes. The designs will be found in harmony with those of the very best manufacturers and they can be worked out by the amateur for making useful instruments.

Fully Illustrated. Price, \$1.50

POPULAR SCIENCE MONTHLY
250 Fourth Ave. New York City

A Four Square Financial Plan

(Continued from page 6)

Savings bank balance including accumulated interest.....\$ 1,000

Total financial worth....\$60,000

We strongly recommend that you start the four-square financial plan and adhere to it as closely as possible.

To Help You Get Ahead

THE Booklets listed below will help every family in laying out a financial plan. They will be sent on request.

How to Build an Independent Income (1917 Edition)—Describes a plan for buying 6½% First Mortgage Bonds by payments of \$10 or more a month, and shows the results that may be accomplished by systematic investment. Address: The F. H. Smith Company, Smith Building, Washington, D. C. Ask for Booklet 75.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

Behind the Scenes where Bonds Are Made tells how you can retire in fifteen years and have an income equal to your present living budget. This booklet can be secured by writing to Cochran and McCluer Company, 46 North Dearborn Street, Chicago, Ill.



FIDELITY MEANS KEEPING FAITH

Assurance

Life is full of promises when hearts are young. A good time to insure fulfillment by inaugurating a definite savings plan.

Fidelity's booklet, "The House Behind the Bonds," will help you. It explains the importance of buying first mortgage investments secured by the right kind and amount of physical property; and how the reputation of the issuing bond house contributes to this safeguard.

Whether or not you contemplate purchase of Fidelity 6½% Guaranteed Bonds, send for this booklet. No charge and no obligation.

FIDELITY
BOND & MORTGAGE CO.
INCORPORATED IN ILL.

660 Chemical Bldg., St. Louis
1188 New York Life Bldg., Chicago
315 Colorado Nat'l Bank Bldg., Denver

FIDELITY GUARANTEES EVERY BOND

SAFE BONDS in Safe Cities ---



that pay you **6½%**
on investment funds
or monthly savings

MODERN, income-producing property offers exceptional security to the first mortgage investor, because the income from the property provides a constant source of funds from which interest payments can be made promptly, and a substantial part of the principal paid off each year.

It is such security as this, located in important and thriving cities of the United States—cities where rental demands are well established and where real estate values and economic conditions are sound—that protects your investments in **SMITH BONDS**.

Now you can get a 6½% return, with this strong security, and with safeguards that have resulted in our record of

**No Loss to Any Investor
in 54 Years**

SMITH BONDS, in \$1,000, \$500 and \$100 denominations, are sold outright for cash or under a plan that pays the full rate of bond interest—6½%—or regular monthly payments of \$10, \$20, \$50 or more.

Mail the form below for our booklets, "Fifty-Four Years of Proven Safety" and "How to Build an Independent Income."

THE F. H. SMITH CO.

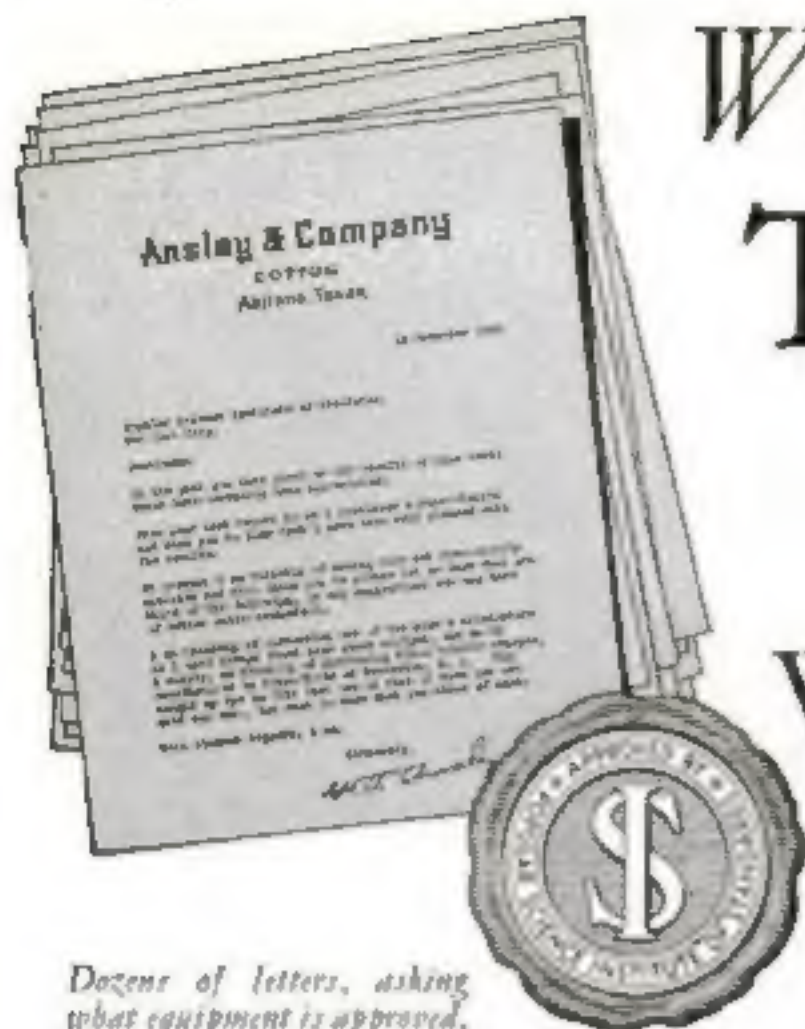
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Name..... 75-22

Address.....



Dozens of letters, asking what equipment is approved, come to the Institute daily

What THOUSANDS DID — Who Were Buying Radio, Tools and Oil Burners

TO AID readers in their buying problems, to determine that only reliable products were being advertised and to make POPULAR SCIENCE MONTHLY a still better magazine—these were the three aims the publishers had in mind in establishing the Popular Science Institute of Standards.

The Institute has been functioning three years now and these aims have been realized to an even greater extent than was expected. The fact that eleven thousand readers have come to the Popular Science Institute of Standards for advice in buying radio, tool and oil burning equipment shows that there was a real need for such a buying service as the Institute offers. Products offered for advertising have been carefully investigated with the result that advertising space has been refused to numerous concerns manufacturing equipment that failed to measure up to the rigorous standards of the Institute of Standards. And, in contacts with readers, comments are repeatedly made on the improvement and raised standard of the magazine.

At the time that the Institute was established, it was recognized that a staff of experts and the expenditure of considerable time, ingenuity and money would be necessary. Under the direction of Professor Collins P. Bliss, who is head of the mechanical engineering department and director of testing laboratories at New York University, a group of engineering and electrical experts have been constantly working. Their first problem was to devise tests and testing equipment. Practically nothing had been

done along the lines of radio and tool testing previously, no apparatus had been de-

signed with which to make such tests, nor had standards of efficiency been established. Ingenious and thorough test methods were worked out which have made it possible for the Institute to definitely separate reliable, dependable equipment from equipment of questionable worth. All this required more thought, labor and apparatus than was first estimated, but it has enabled the Popular Science Institute to answer definitely the question: "Will the tool or radio equipment give satisfactory service to our readers?"

In the case of oil burners, just as definite information has been obtained in a different manner. It was found that it was not feasible nor practical to test this type of equipment. To get authoritative information on the subject, it was necessary to question home owners who had been using an oil burner for one or more years. So

POPULAR SCIENCE MONTHLY sent investigators into 1500 homes all over the country. Then 1500 other oil burner owners were questioned by mail. The combined results were tabulated and chartered, giving a clear picture of the findings.

As a result, the Popular Science Institute of Standards knows more about domestic oil burners on the market and the degree of satisfaction the different makes are giving than any other organization in the country. Not only Popular Science readers, but hundreds of other prospective oil burner owners who have heard of the survey, have made their selection of a burner on the Institute's advice. There is no charge for such service but information must be given on the size of the house to be heated, its heating system, annual coal consumption, and as to whether gas and electricity are installed. Such information is essential if the Institute is to advise authoritatively.

AS TO the principles by which the Institute is governed, it must, and does, present only the actual facts discovered. It is for this reason that its findings are entirely unbiased and have no relation whatever to the advertising side of the radio, tool and oil burning industries in connection with POPULAR SCIENCE MONTHLY. The Institute of Standards approves on the evidence presented by its tests and investigations and those are made as extensive as is necessary to bring out the truth regarding a product.

The Institute's advice is at the disposal of every reader who is buying radio, tool or oil burning equipment. For lists of such products that are approved, and for other information, address the Popular Science Institute of Standards, 250 Fourth Ave., New York, N. Y.

Popular Science Monthly GUARANTEE

The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by POPULAR SCIENCE MONTHLY. THE PUBLISHERS



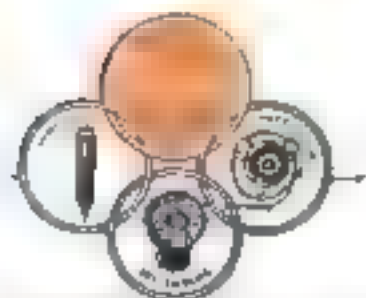
Steel Makers use Tycos - the Sixth Sense

THE making of steel and steel products has become a "fine art" through the introduction of exact control and regulation of heat. From the first smelting of the iron ore to the making of fourteen inch navy guns or the hair spring of a wrist watch the steel is constantly going through heat treating processes. And Tycos Instruments for Indicating, Recording and Controlling of heat are in constant use for eliminating spoilage and insuring uniformity of quality that is the essential of mass production.

Tycos Instruments are the Sixth Sense of the Steel Industry and every other industry where heat processes are used. Tycos Instruments insure the accuracy of automatic control.

Whether you make steel by the ton or bread or paint or perfumery or phonograph records or any other product that requires heat treatment in its making you can use Tycos "Sixth Sense" in your plant.

Tycos Engineers have effected substantial economy for manufacturers in every line of industry by applying the Tycos "Sixth Sense." Whatever your problem in the indicating, recording or controlling of heat, there is a Tycos Instrument to serve you. Write us for literature on any instrument, or type of instrument, and it will be sent promptly. Or, if you prefer, our engineers will consult with you on the application of the Tycos Sixth Sense in your plant.



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You dealer will have them in stock. If not, write for literature on this and other Tycos instruments.

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Ample Voltage—Self-Adjusting—Quiet

After two years of intensive development, Grebe has produced a power unit that is:

Durable—Designed and built for long, reliable service by a company that has made superior radio apparatus for over seventeen years. Its ample power reserve brings out the best tones in your set. "C" voltages automatically adjusted for changes in "B" voltages.

Quiet—No "motor-boating", hum, or noises from variable voltage contact adjustments. Shielded against outside impulses.

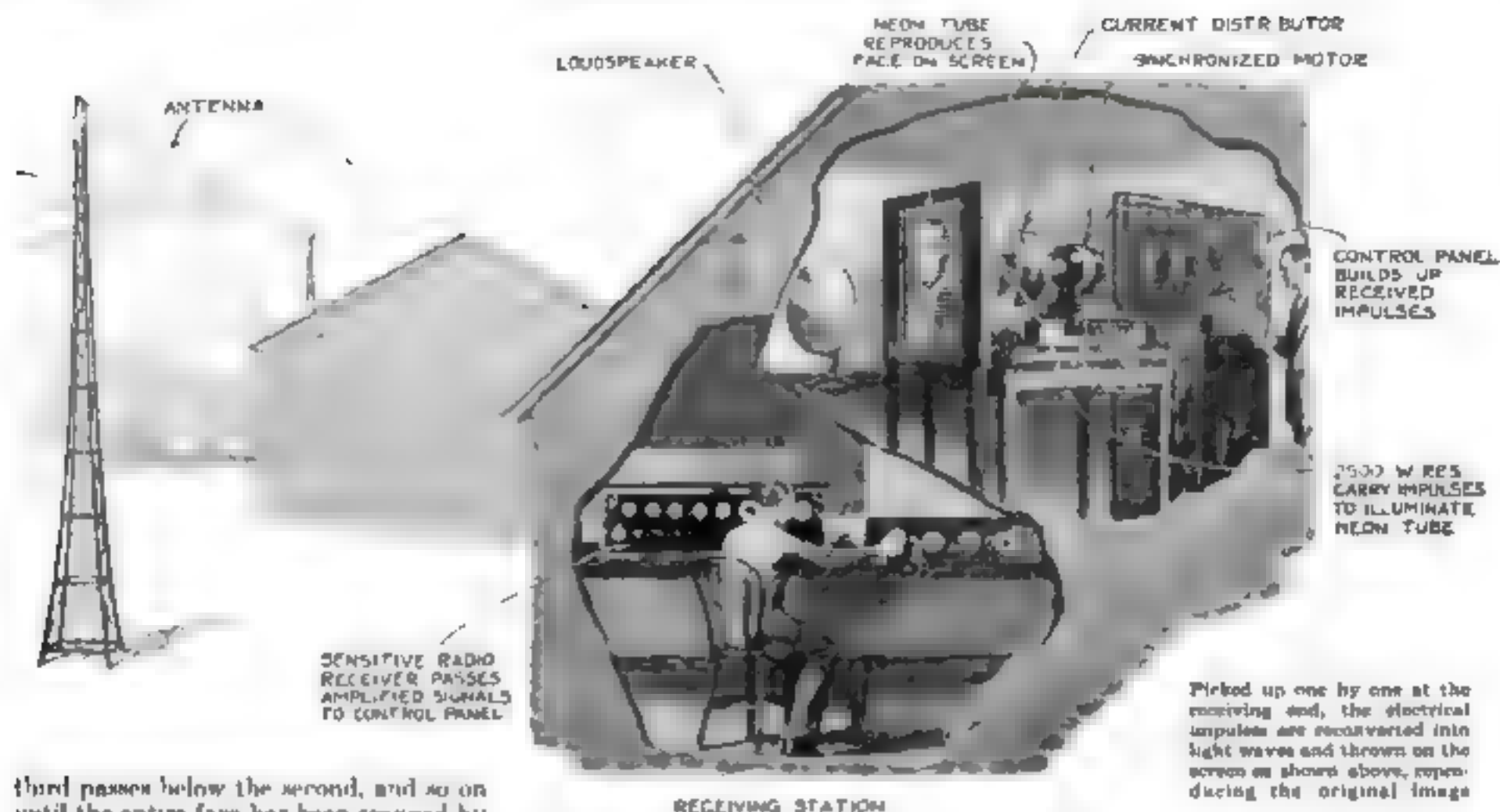
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third passes below the second, and so on until the entire face has been scanned by the light beam in fifty parallel lines. The procedure is repeated again and again in a succession of pictures. Meanwhile the photo-electric cell is recording every variation in light and shadow in terms of electric current.

Of course, you cannot see the moving beam of light, for, you remember, it scans the entire face once every eightieth of a second. It moves so swiftly that it appears as if the face were bathed in a continuous flood of light. Yet the electric eye follows every move.

The electric current which bears the record of what the eye sees is, however, too feeble to do the work required of it. So it passes through vacuum tube amplifiers, where it is magnified 5,000,000,000,000,000 times. Then, from the antenna of station SXN, the magnified impulses ride out into space on the back of a radio carrier wave—an electrical "flying pic-

ture" of the comedian there in the studio.

Enter, now, another room, miles away, where these picture impulses are received. You will observe that they are reproduced in one of two different ways. If only one individual is looking in, he sits at a cabinet containing a small, translucent screen measuring about two by three inches. On the screen the animated face of the comedian is registered clearly and sharply, while his voice is heard from a radio loudspeaker. But behind the little screen astonishing things are happening.

Reaching the receiving antenna, the picture impulses are picked up and amplified much as in ordinary radio reception. Then they are led to a tube filled with neon gas and containing two electrodes. As the current leaps across the electrodes, each impulse causes the gas to glow. This flash of light is strong or weak, according to the light or shadow of the particular fragment of the face to which the electrical impulse corresponds.

Between the neon light and the screen is a second revolving perforated disk, an exact duplicate of the disk at SXN and timed to run at precisely the same speed. Through the perforations each successive fragment of light is made to land in its appointed place on the screen and at precisely the right time to play its rôle in reproducing the original face.

If a number of persons are to view the image, the screen is much larger, measuring perhaps two by three feet, and consists of a very long neon tube folded back and forth to form a large

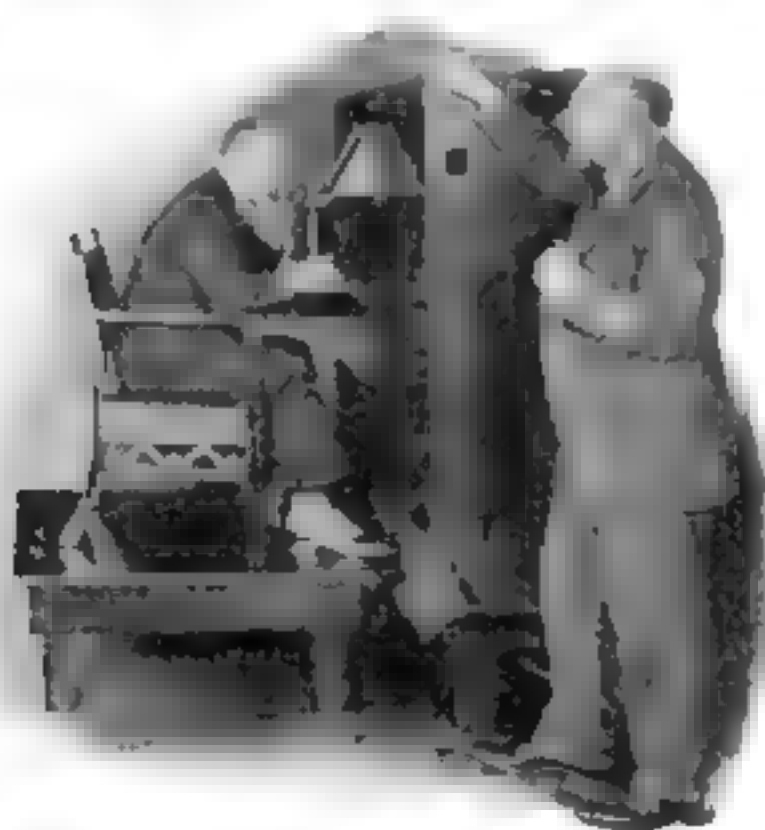
rectangular grid or screen. The tube is divided into 2500 little sections, arranged in fifty parallel lines of fifty sections each, each section corresponding to one of the fragments of the face scanned by the photo-electric cell in the transmitting station.

Within each of the 2500 sections are two electrodes, connected by wires with an apparatus for making and breaking electrical contacts. This is a brush mounted on a wheel which revolves in exact time with the scanning disk at SXN. As each electrical bit of flying picture is received, the brush delivers it to the proper wires leading to its appointed section on the screen. There, in passing across the electrodes, it causes a flash of light similar in location and intensity to the corresponding spot of light on the original face.

Eighteen times a second, each of the little sections thus shines forth in turn. The succession of flashes is so swift that human eyes cannot note them separately. The observer sees them not as a series of distinct flashes, but as an entire picture. The picture is viewed either directly on the gridlike tube or through a translucent screen.

THE system is virtually the same by wire as by radio. Its success lies largely in the remarkable synchronizing of motors controlling the apparatus in both the sending and receiving stations. Were it not for this, the thousands of little picture units would fail to reach their proper destinations, and the result would be a blur. To aid in the tuning, a secondary or governing motor is employed in connection with the main motor in each station. In radio vision the tuning process is controlled electrically over a wave length different from the one used in actual transmission. The voice is carried on a third wave length. In wired television three separate wires are used.

The development of this marvelous system was effected (*Continued on page 130*)



At the "seeing" end: W. S. Gifford, president of the American Telephone and Telegraph Company, watching Secretary Hoover in Washington as he talks in him from New York. Standing is Dr. H. S. Ives, who directed development of the television apparatus.



A New Self-Start for Airplanes

From a machine that can be air-started the way of an airplane. This new self-starting device is a marvel of modern engineering. It makes it possible to start an airplane in a few seconds by button. It is a simple and easy to use device. It is a marvel of modern engineering. It makes it possible to start an airplane in a few seconds by button. It is a simple and easy to use device. It is a marvel of modern engineering. It makes it possible to start an airplane in a few seconds by button. It is a simple and easy to use device.



Turbine-Driven Gearless Car

The latest development in gearless cars is the turbine-driven car of James H. Dyer of Chicago. It is a marvel of modern engineering. It makes it possible to start an airplane in a few seconds by button. It is a simple and easy to use device. It is a marvel of modern engineering. It makes it possible to start an airplane in a few seconds by button. It is a simple and easy to use device.

New Marvels of Ingenuity

A Light That Pierces Fog — Pictures on the Clouds—Other Amazing Ideas and Discoveries



Strange Light Pierces Fog

A wonderful new light designed to pierce fog and haze. It is a marvel of modern engineering. It makes it possible to start an airplane in a few seconds by button. It is a simple and easy to use device. It is a marvel of modern engineering. It makes it possible to start an airplane in a few seconds by button. It is a simple and easy to use device.

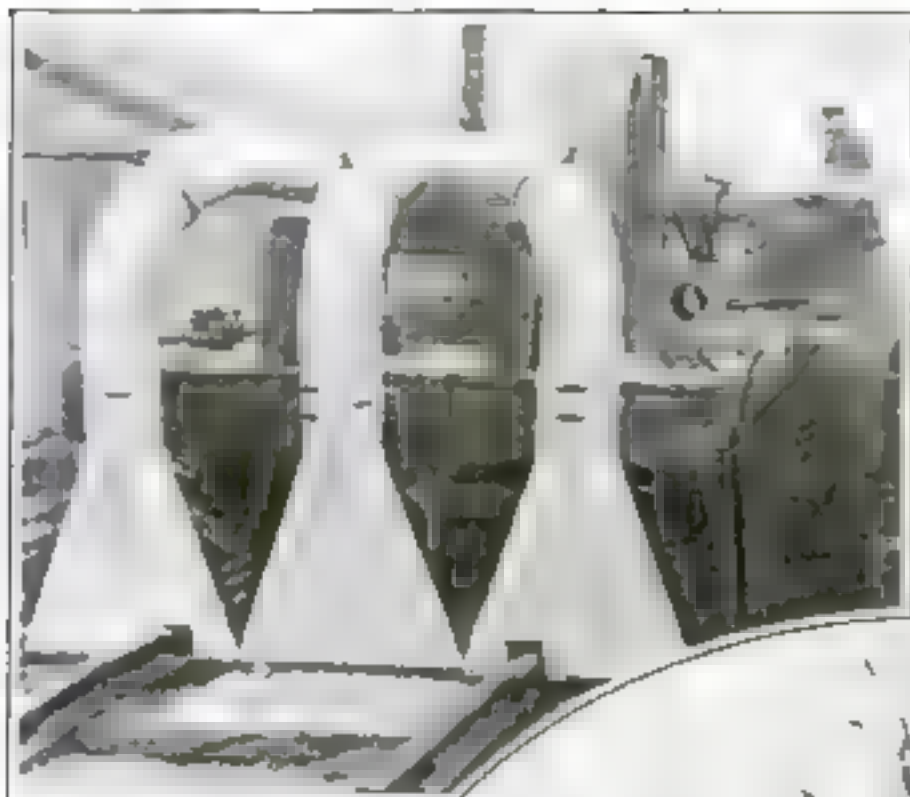


Power and Speed

The turbine-driven car is a marvel of modern engineering. It makes it possible to start an airplane in a few seconds by button. It is a simple and easy to use device. It is a marvel of modern engineering. It makes it possible to start an airplane in a few seconds by button. It is a simple and easy to use device.

Danglers in a Basket

To study the wonderful formations of the famous Niagara Gorge at Niagara Falls, N. Y. The famous Niagara Gorge is a marvel of modern engineering. It makes it possible to start an airplane in a few seconds by button. It is a simple and easy to use device. It is a marvel of modern engineering. It makes it possible to start an airplane in a few seconds by button. It is a simple and easy to use device.



Housecleaning on the Tracks

[illegible]

The End of a Run? Ship

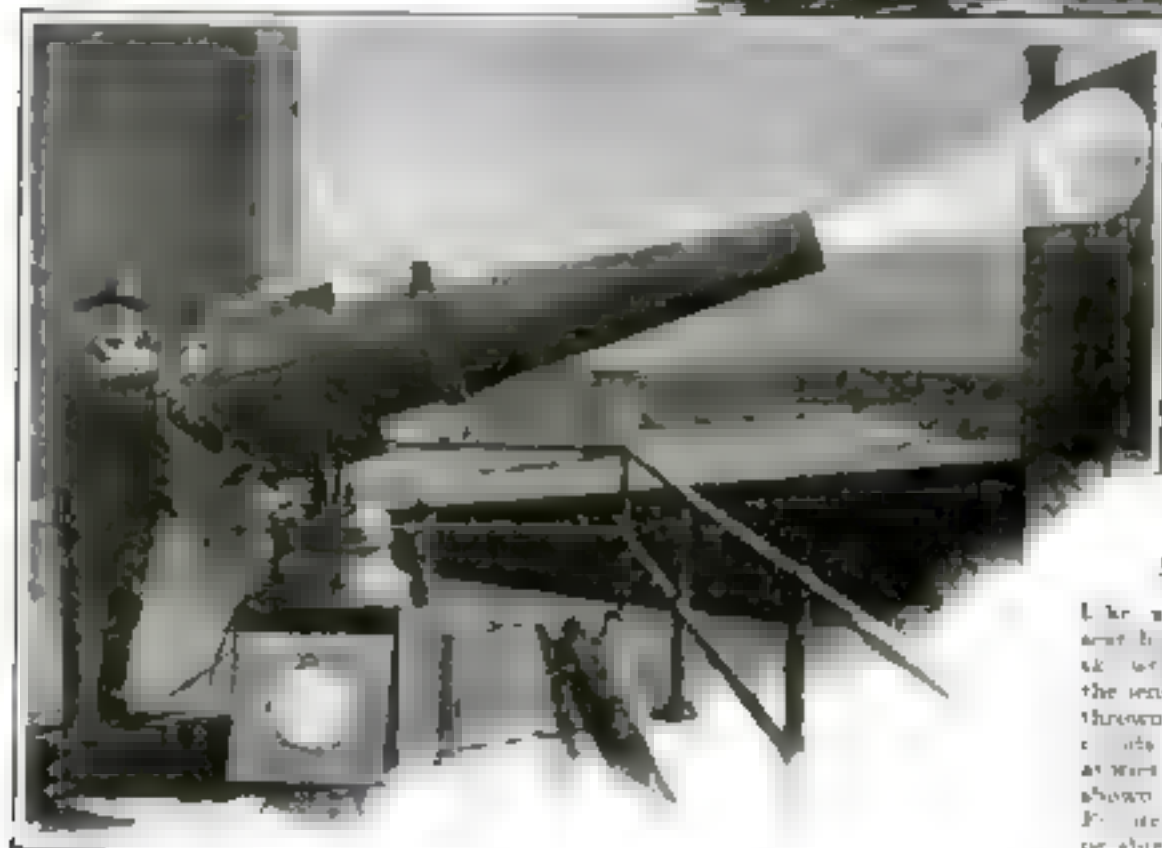
1. The first part of the document is a letter from the President of the United States to the Congress, dated January 1, 1861. It is a copy of the original letter, and is signed by Abraham Lincoln. The letter is addressed to the Senate and the House of Representatives, and is dated January 1, 1861. The letter is a copy of the original letter, and is signed by Abraham Lincoln. The letter is addressed to the Senate and the House of Representatives, and is dated January 1, 1861.



Win a Millions for Inventors

[illegible]

The Latest in "Zeppelin" Features

[illegible]

Shoots Pictures on the Clouds

Like a naval mine, the instrument is a gun and is set out to fire in a new way. It is a "gun" because it is inserted between the verses in the bass of the organ pipe and is thrown in a giant letter and in a new overhead position. The instrument was developed in the name of the German Electric Company. The model shown above contains an angled air vent light. It is made of a very thin, clear plastic, and is able to burn brightly up to five or six inches.

Black Death

By

FITZHUGH GREEN

A Naval Officer's Vivid Story Revealing Inside Workings of a Submarine

THERE was a touch of mystery to the scene: two ships at a dead stop in the center of an otherwise empty ocean; weather clear as a bell, fresh breeze out of the north; sea sparkling in the June morning sunshine and flecked with whitecaps. The kind of day when ships should be about their business.

These two weren't. Or, if they were, surely there was a very strange business.

One of the ships was a submarine, the U. S. S. V-5. To the lay eye she was merely one of those long, low black hulks, such as the ocean traveler grew so to fear during the war. But a Navy man at once would have spotted, forward of her conning tower, a curious bulbous growth.

On the bridge of the U. S. Naval Tender *Falcon*, the other vessel in the scene, the senior submarine officer of the American Navy was pointing to this bulbous growth and speaking with great earnestness.

"But it may mean death to thirty men, sir!"

Admiral Bowers, Chairman of the Secret Submarine Committee, bit nervously at his short white mustache. "Why do you say that, Commander Drake?"

"Because you can't cut a gaping hole in the top of a sub and install a movable cylinder as big as a boiler without weakening her structure!"

Drake's hands gripped the *Falcon's* screen rail until his knuckles showed white. Surely he was the embodiment of physical vigor. He stood, legs wide braced, sailor-wise, his lanky body swayed slightly forward so that his posture, as well as his strong chin and fine ruddy features, gave him almost an air of defiance.

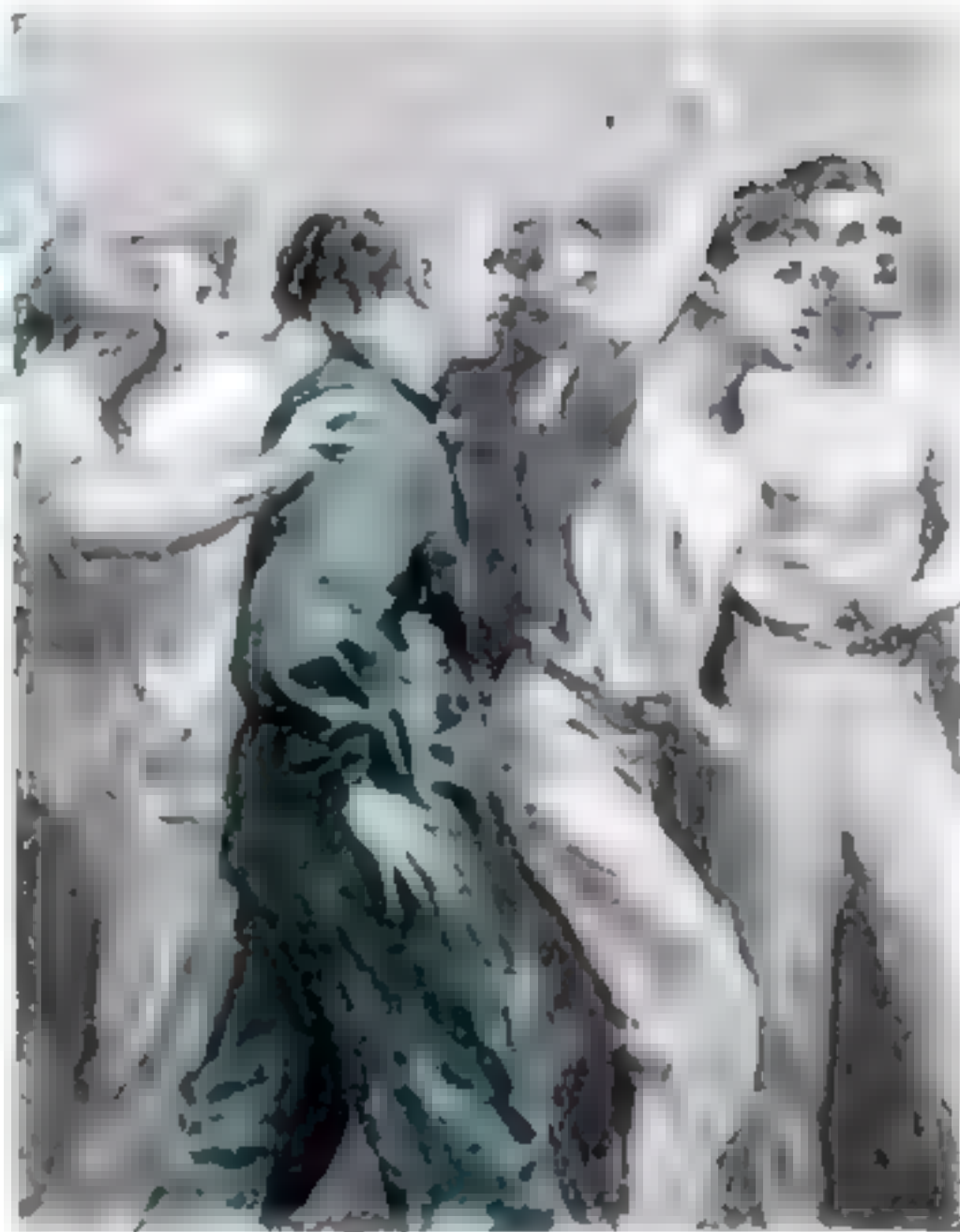
A third man joined the two. He was a lean individual with an oversized head and pale face. His spectacles and stoop classed him as the academic type of man.

This was the famous Dr. Sigmund DeFrees, internationally known as an inventor and designer. The name DeFrees already belonged with those of immortals such as Edison and Diesel. Long Commander Drake had been selected from a long list of experts to face, in this secret test, the gravest crisis that had confronted the United States Navy since the declaration of war in 1917.

"Still worried?" inquired Dr. DeFrees affably.

Drake shrugged. "I'd hardly call it worry. After twenty years of submarines a man doesn't worry."

"Ah, but the practical operation of a submarine is so vastly



Illustrated by B. J. Rosenmeyer

removed from the fine points of its design." DeFrees' tone was both patronizing and genuinely amused. To him Commander Drake, for all his years of seafaring aboard submarines, was but a highly trained chauffeur.

The inventor turned to Admiral Bowers. "The Secretary will be up for the first dive, won't he?"

As if in reply, there arrived on the bridge a judicial looking man with a kindly face, the civilian Secretary of the Navy. His presence at this secret test was token of the seriousness of the occasion.

"All ready, Commander Drake?" he asked.

"We're just waiting for the navigator to check our position, sir. Soon as we have the right depth Dr. DeFrees and I will go aboard the V-5 and submerge."

"Just a preliminary test," put in Admiral Bowers. "We want to be sure Dr. DeFrees' cylinder fittings will stand the pressure."

THE admiral nodded toward the bulbous growth atop the V-5. This unnatural swelling was the upper end of the "DeFrees Releasing Turret," a device intended to make possible the escape of men trapped in a submarine at the bottom of the sea.

The invention consisted of a cylinder of steel about ten feet in diameter and six feet in vertical dimension, inserted into the upper body of the submarine. It had a small water-tight door near its floor and a hatch at its top. It was designed so that in emergency the crew of a submarine could take refuge in it and, after shutting themselves in, release it from the mother boat. Contained air would float it to the surface of the ocean.

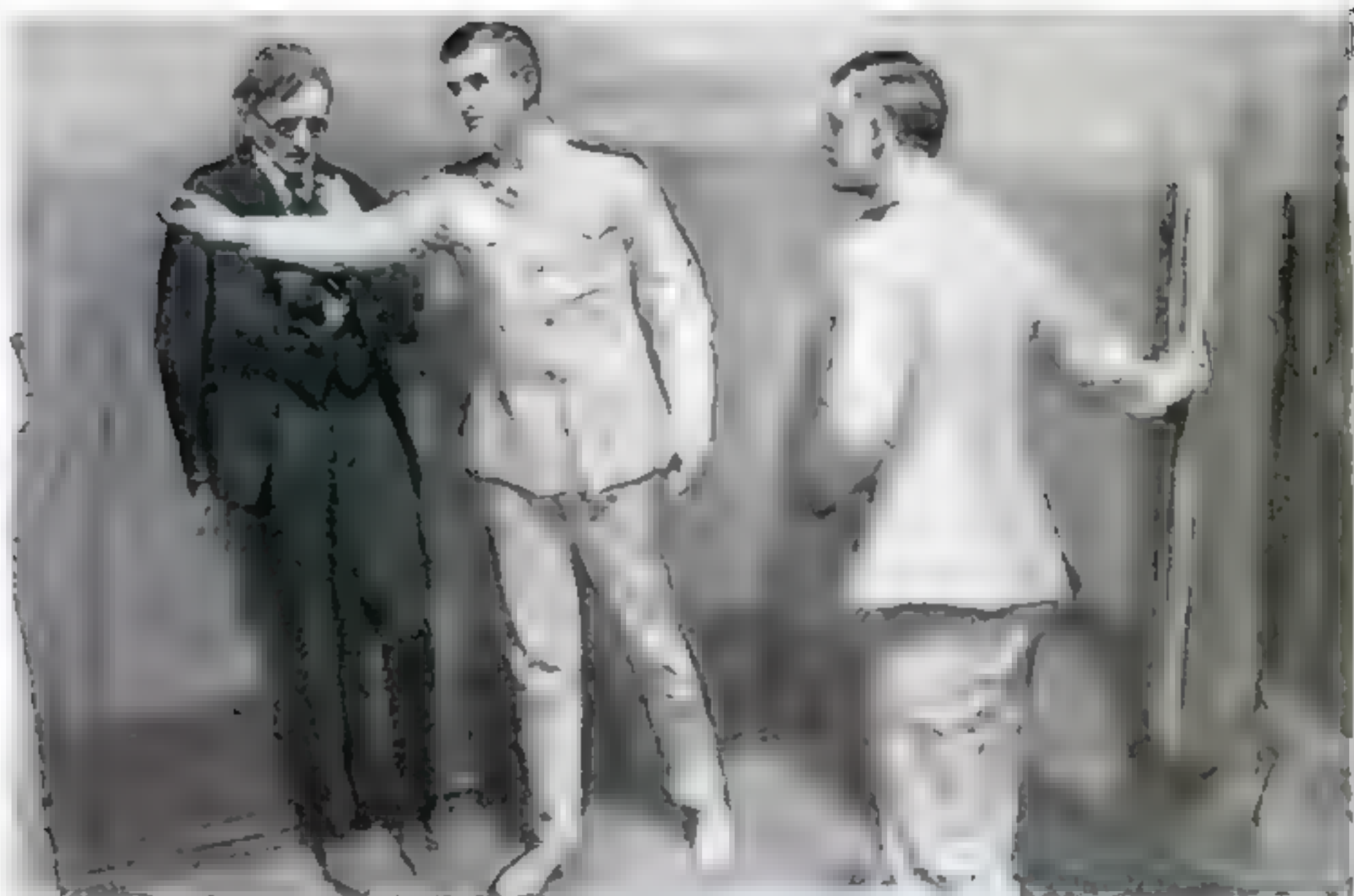
The Secretary questioned Drake: "You still doubt that this device will work?"

"I am willing to take a chance, if it will make submarines safer, sir. I believe, though—"

Dr. DeFrees interrupted. "He isn't taking a chance, Mr. Secretary," he said impatiently. "None of those men are."

"But you admit, doctor, that you have been down in a submarine only once or twice."

The inventor wrung his long-fingered hands. "But you don't understand, sir!" he cried. "As I have tried to drum into



Commander Drake faces the sort of hugger-mugger which goes on in his mind. "I hope," he said wistfully, "I'm not going to stick with the old girl." There was a hint of Mexican "Y" in it.

Commander Drake, when we can calculate the stress and strain on the skeleton of a submarine's structure to the fraction of a pound!"

"But they still kill men," said Drake drolly.

DeFrees' pale face reddened with anger. "Mr. Secretary, you know as well as I that the Navy has suffered six horrible submarine disasters this year! The people won't stand for this sort of thing much longer. Public opinion will force Congress to scrap every submarine you have. The President will not dare interfere!"

THE Secretary held up his hand. "We know all that. Congress has directed us to test your device because it looks promising. But we have brought Commander Drake all the way from the Pacific to handle the experimental boat because he is the best submarine officer we have."

"I don't doubt it," agreed Dr. DeFrees ironically.

"He has a picked volunteer crew on the *X-5* to take you down. If there is trouble—"

"Which there won't be," snapped DeFrees.

The *Falcon's* navigator stepped up to Admiral Bowers and saluted.

"We have reached the spot, sir."

The admiral glanced about the horizon where a cloudless sky met the blue sea. Hull-down northward were visible the disappearing masts of a vagrant schooner. A low haze in the west told where the land had faded out some hours before. Save for a sea gull or two and the black bubble of the *X-5* ahead, naught else was in sight.

"Here we are, Mr. Secretary."

"All right, Bowers, go ahead."

A flag shot to the *Falcon's* yardarm. While the *X-5* flickered aloft her answering pennant, the admiral added:

"We chose this spot, sir, because it has the necessary depth. We have just crossed the thirty-fathom line. That means we can keep our party private."

A few moments later the Secretary of the Navy warmly

clasped the hands of Commander Drake and Dr. DeFrees, and the *Falcon's* whalerant carried them to the *X-5*. On the low deck of the submarine a man trotted forward and disappeared through her torpedo hatch, closing it after him. Another swung shut the engine room hatch aft. A busy movement about the tiny bridge atop the conning tower at the center of the submersible soon resolved into a quick final housing of signal gear and other movable articles. A faint shout drifted across the intervening water.

Aboard the *X-5* all hands stood at quarters. Already Dr. DeFrees, grumpy and slightly irascible, was below giving final touches to his invention.

"Stand by to submerge!" ordered Commander Drake crisply. Placing his lips to the voice tube in front of him he repeated the command, which was passed forward and aft. Men in the torpedo room at the bow sprang to their tubes, cocks and valves, to make sure they were tight. Those aft in the engine room stood by to shift propulsion. This last was necessary because the modern submarine is but a big steel torpedo propelled by oil engines on the surface and by electric motors drawing current from storage batteries when submerged. Oil engines need air that is not available under water. Hence the shift at diving.

"STAND by ballast tanks!"

S Men at the admission valves prepared to let water flow into the big side chambers that run the length of every submersible and govern its buoyancy. Not only can these tanks be filled by opening valves and emptied by running heavy ejection

pumps, but automatic pumps keep the boat's balance by altering the amount of water ballast in them when men and material are moved forward or aft.

Receiving a report of "ready" from all operating stations, Drake directed his assistants to shift to the "control room." This is the inclosed space directly beneath a submarine's bridge in which are clustered the many intricate valves, wheels, gages, dials, bells, and other appurtenances vital to the operation of the boat. It is the operating room proper. From this point torpedoes may be fired, engines started and stopped, horizontal and vertical rudders manipulated, and every man in the crew reached at an instant's notice.

In the control room Commander Drake looked into the periscope, "the tube that sees around a corner" as it is sometimes called. At the upper end of this tube was a prism kept dry by a thin air blast. The prism bent light rays coming in, thus permitting the eye below to look about the sea's surface so long as the prism itself was above water.

"All clear?" queried Drake.

"Clear, sir, and ready," snapped back Lieutenant Harbord, his second in command, a slender sunburned lad in his late twenties.

"Down rudder! Tanks!"

Instantly the *X-5* began to settle. Slowly her depth gage swung over: two fathoms—five fathoms—ten—twenty—

"Easy!" from Drake.

The helmsman "met her" with his horizontal rudder planes.

"Twenty five," read the gage.

"Up rudder!"

"Thirty" lay under the gage arrow.

DRAKE thrust his lips to his tube. "Pumps!" he bellowed. "Stop flooding the main tanks! Begin ejection!"

He stepped back and wiped his forehead.

Harbord's head appeared through the water-tight door. "Thought this was a thirty-fathom spot, skipper," he said.

Drake glanced at the gage. It showed thirty-five fathoms!

"For the love of Pete!" he shot back. "That's what they told me! This must be a depression in the bottom. All we need is thirty to give the doctor's cylinder a test. Jump back and see what those hams are doing."

Harbord disappeared. But the depth gage did not move.

"Got up rudder on her?" Drake growled at the helmsman.

"Yes, sir, full up rudder."

Still the depth gage did not move. To an old submarine officer like Drake this fact was ominous. He sprang through the door leading aft to the engine room, and crashed head-on into a man just stopped in the waist.

"Oh, I'm sorry," began Drake, helping the man to his feet. But the latter did not wait for him to finish.

"We're sinking, sir!" The words rattled out in the high pitched falsetto of fear.

"Sinking, how?"

"Main—main battery room port—flooded—!"

Drake did not wait for more. He plunged across the narrow deck to the door leading forward. He hurdled through and landed with a splash on his feet in six inches of water.

There was no panic. But for a few minutes the *X-5*'s main deck was a scene of swift action inspired by the common knowledge that pressure of the sea outside had sprung a seam leading to the flooded battery room, which in turn had, at the moment, an opening forward into the torpedo room and amidships into the main deck.

JUST as Drake had feared, the coming out of a large cylindrical space for the DeFrees turret had weakened the integral structure of the vessel. Theoretically, even the weakened seams should have withstood the pressure she had descended into. But it so happened that a heavy sea had caught the *X-5* at the moment she went under. In consequence she was rolling when she reached twenty fathoms. Thus to the terrific pressure of 140 tons of solid water above her was added a twisting movement which the theorist ashore in his study would not likely have anticipated.

As a result, a side plate that ordinarily would have been supported by a thwartshipstrut, removed to make room for the DeFrees turret, buckled under the thousands of pounds of pressure, and several of its rivets collapsed. Instantly tons of water rushed in before the horrified seamen had time to close water-tight doors and isolate the flooded space.

Drake quickly saw what had happened. A gleam in his eye showed his appreciation of quick action by two torpedo-gunners in getting the doors shut before the *X-5* was completely lost. Then he turned back to the control tower. Thirty men had placed their lives in his hands and he must not fail them.

Unexpectedly Dr. DeFrees blocked his way. In the excitement Drake had almost forgotten the inventor. Now he gazed into the man's pale face.

It was easy to see that DeFrees was much shaken. His lips were colorless and his hands twisted nervously.

"A little leak?" he asked in a desperate effort to hide his fear behind facetiousness.

"Yes—sure," replied Drake mechanically. He brushed by the inventor and dashed back into the control room. Faces of the men he passed were tense. They, too, sensed the dreadful fact that at any moment the *X-5*'s plates might crack again and admit another flood.

Even as Drake sprang through the water-tight door to his valves and switches the men had begun to gather in little helpless groups and whisper among themselves.

"Black Death!"

The Navy term for what happens when a submarine goes down and snuffs out the lives of her men. Would it enter the *X-5*?

Again Drake barked his commands.

"Main pumps on torpedo room! Full—ahead!"

He was a man clear through. But fear gripped him now; the kind of fear which, to the brave man, is a tonic for swift action and terrific effort.

SWEAT poured from the face of the machinist at the main clutch as he swung his lever over. Fear gripped him, too. But, unlike Drake, he was fully conscious of it. To him "Black Death" was a far more visible horror.

The pumps groaned and the engines spun until their oily packing began to smoke. But the depth gage pointer in front of Drake's staring eyes seemed glued at thirty-five fathoms. This depth was dangerously great. Weakened seams might start at any moment under the pressure and admit more water. The men would die before a rescue could possibly be organized above them.

"Stop!" rasped Drake. To Harbord he barked. "Get all hands but those at pumps and switches. Sally ship!"

"Aye aye, sir!" Harbord mustered the men into a "sally ship" gang. Under his sharp orders this party ran back and forth across the main deck in a frantic effort to shake the *X-5* loose, while Drake operated the controls.

For twenty minutes the feverish struggle went



Men struggled in the main deck, dragging the vessel up by section. Slowly the *X-5* was tilting upward.

on. Torpedoes which had cooked just from their waiting to a condition of a positive death now were pressed. These same torpedoes then and went back. The rest of the torpedoes in engine room had been through the broken row and Henry Drake's sharp "Starboard! Port! Starboard! Port!"

Their efforts were futile. "Hold everything!" cried Drake.

The engine room had become a sweltering prison, almost undrivable from the thick smoke of overheated lubricating oil.

"Harboard, man the oscillator! Don't let the operator be stupid. Tell the *Falcon* we're down and stuck here. Make it snappy!"

"Aye aye, sir."

THE panting crew propped themselves against the *X-5's* clammy bulkheads while the junior officer hurried forward to the electric vibrator which could shoot sound waves under water to a receiving diaphragm in the outer skin of the *Falcon*.

Two minutes later he was back facing Drake.

"Oscillator flooded, skipper," he said.

"It can't be!"

"It is, skipper."

For a moment Drake buried his face in his hands. "You know, as far as there's no rescue craft closer than New York."

Harboard nodded.

"And the only pontoon unit on this coast is at Boston. So if we can't signal to the *Falcon* nothing will start toward us today."

To both men, after many years of service in the "eggs," their plight was plain. Long before drags could locate the *X-5* to rise in her, if they had not drowned, would have gasped their last unguished breath. The *Falcon* was helpless. So far as she was concerned, when her oscillator failed to rouse the submarine the admiral and his companions could come to any conclusion: for all they knew, the *X-5* might already hold the lifeless bodies of her crew. Her silence might mean anything from an explosion to a ruptured beam.

Drake stepped to Harboard's side. "We mustn't weaken, old man. Those lads out there are scared stiff already."

"So am I," said Harboard frankly.

Drake forced a smile. "Remember that the boss of the whole works is up there on the *Falcon*. The Secretary can move any slip in the Navy. He'll stick right by us. The weather is fine."

"I know, skipper, but"

In the doorway stood Dr. DeFrees! His ashen face twitched, as he sought to conceal the terror that had already drenched his garments with cold sweat.

"Guns—we'd better—try my cylinder," he stammered.

"Can you beat it?" exclaimed Drake. "Honestly, doctor, in all the excitement I hadn't even thought of it!"

"But there isn't any other way, is there?"

"Not that I know of. We're flooded down forward. Our pumps can't handle such pressure. We're down too deep to send a man up through our torpedo tube even if we could get



Dr. DeFrees' face reddened with anger. "He isn't taking a chance, Mr. Secretary," exclaimed the inventor. "None of these men are."

to the torpedo room. We haven't enough ballast to change her trim. We can't communicate with the *Falcon*. All we can do is sit here."

"Well, why not use my cylinder?" repeated the inventor weakly. "We came out here for that very thing, didn't we?"

Not a trace of the patronizing air and condescension he had shown toward Drake on the *Falcon* was left in his manner. Rather was he like a frightened child who begs assurance and comfort from the older and more experienced parent.

"All right, let's see," said Drake with a touch of irritation. One could not blame him, since it was the doctor's "Releasing Turret" that was to blame for the *X-5's* predicament.

Out in the main country abaft the control room were gathered the crew. They knew the pumps had refused to work. Sallying hadn't helped the *X-5*. As a seafaring vessel she was deaf, dumb and blind. They knew it meant they might have to die there on the floor of the sea. They were brave men. But it is one thing to face death in the heat of action—another to face it in the glacial silence and inaction of a sanken submarine.

As Commander Drake entered he was surrounded by a circle of silent but beseeching seamen whose doom lay in his hands. He none could save them. Already the air was thick with smoke and the sharp bite of chlorine gas from the batteries.

Drake spoke briefly: "Men, you know that Dr. DeFrees invented the cylinder here behind me. You can enter this cylinder by its hatch—" indicating with his hand—"Then it can be released from us. Contained air will float it to the surface with those inside. This cylinder is not big enough to take all. Those of you who want to risk it can draw lots. The lucky ones can go."

The chief machinist stepped forward. "That's all right, captain. But what do you think about the safety of this blooming thing?"

Drake shrugged. "I don't know much about it, chief. Frankly, I have my doubts whether it will stand the water pressure when it lets go."

DeFrees clicked his tongue angrily, but none heeded him.

"Will you draw too, captain?" the chief went on.

Drake shook his head. "Forget me," he said simply. "I'm in command. So I'll stick with the old girl."

There was no vain glory in the quiet words, no effort at dramatic renunciation. Just a plain statement of fact. But their effect upon the men was electric. Instantly rose a chorus of "Me too!" "I on bet!"

(Continued on page 121.)

Car Makes 207 Miles an Hour

*Giant 1,000-H.P. Auto Demonstrates
New Racing Principles*

By
H. C. DAVIS

To spectators of Major Segrave's spectacular run over the sands of Daytona Beach, Fla., in the *Mystery 5* the roaring car was merely a blur of red gone in an instant. Nothing like its speed has ever been made by man on land.

"I WAS going so fast I couldn't look at the speedometer! To guide the car, I had to focus my eyes half a mile ahead. If I had looked at the dial for an instant I might have lost control. I didn't know the car had made 200 until after the run."

The British speed king, Major H. O. D. Segrave, was describing his recent experience in driving his mammoth Sunbeam racer, the *Mystery 5*, over the sands of Daytona Beach, Fla., for a world's record of 207.31 miles an hour. If you can imagine an automobile covering a city block in less than a second, you may conceive—possibly—of such terrific speed.

The real marvel of the *Mystery 5*, however, is not the record itself but the marvelous way science overcame the mechanical problems presented by the demands of unprecedented speed—chiefly the conquest of wind resistance through its immense power plant and its body design.

Wind resistance, of course, increases in far greater ratio than the increase of speed; to double speed requires an engine not twice as powerful but eight times as powerful. Segrave's car was driven by two twelve-cylinder engines, each developing 500 horsepower. About half of this power was needed to overcome wind resistance,

which at 200 miles an hour amounted to almost half a ton! To the same end, the wheels of the car were hidden under a smooth, blunt-nosed body of radically different design. This projected the air upward instead of against the wheels and axles as in the conventional type of speed car with pointed radiator. The pilot's head was the only object exposed.

Tires, too, played a vital part. The builders spent eighteen months developing tires that would last for three minutes at 200 miles an hour. If a tire had blown out the pilot would probably have been killed instantly.

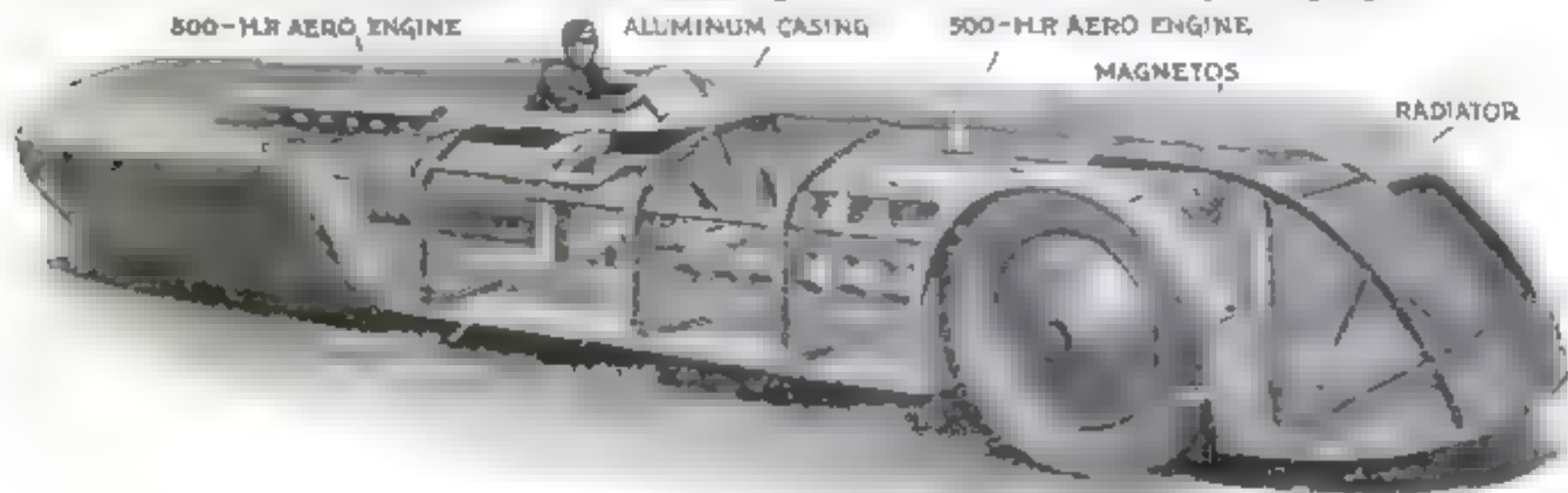
It is a freak car, and Segrave says it will never be driven again. But it has served

its purpose. Besides demonstrating that the present orthodox design of motor car can make 200 miles an hour, it has shown where improvements must be made. The present design of brakes, for example, proved wholly unsatisfactory, the terrific heat generated causing the metal to melt.

Segrave's record is the fastest man has traveled on land. The steam locomotive record is 120 miles an hour. The airplane record is 276—not so far ahead of Segrave's 207.1. Will man ever travel faster on land than that? The British visitors predicted that within eighteen months an American manufacturer would build a car that would break the record made by the *Mystery 5*.

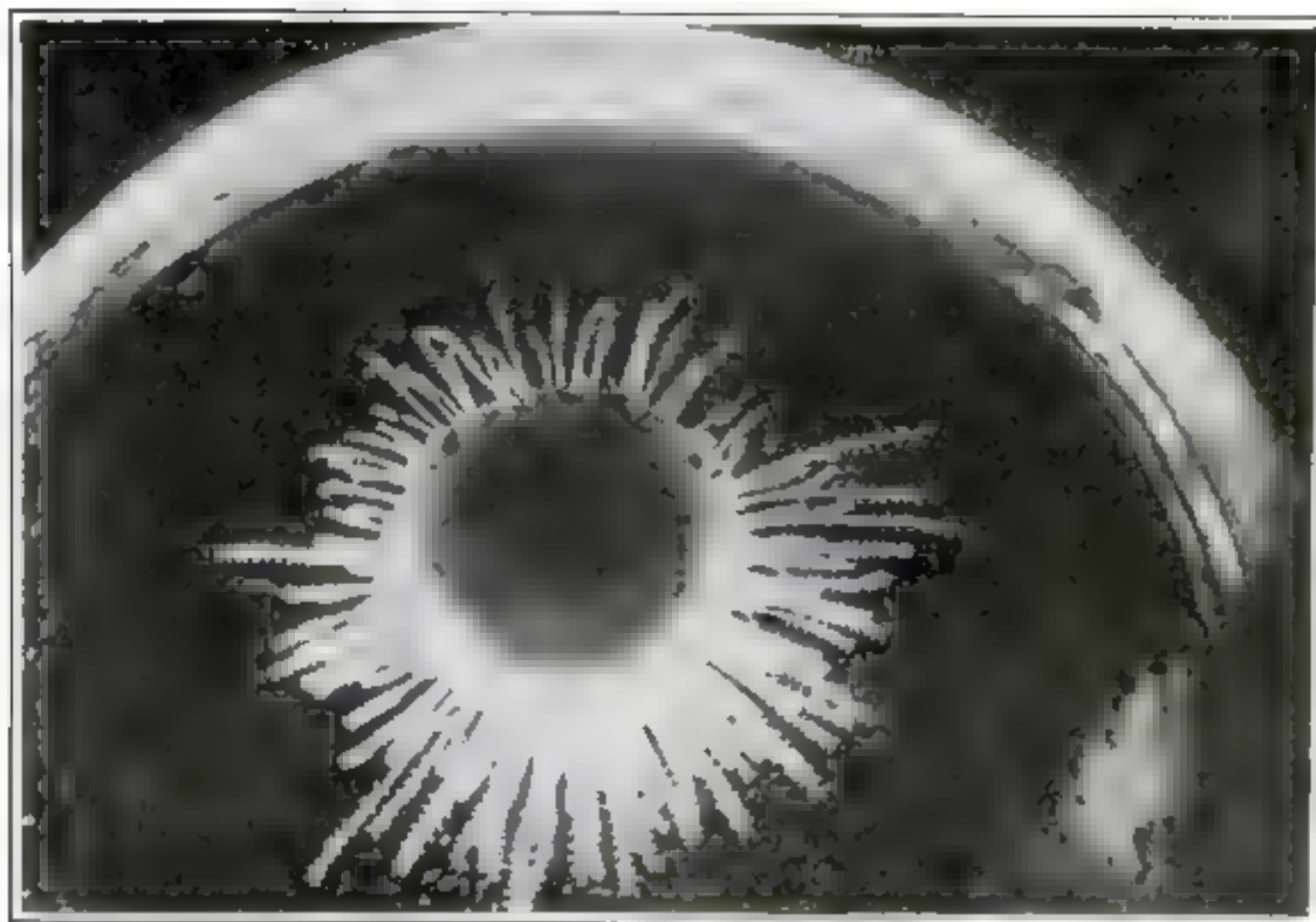


The victorious pilot, wind-blistered and with wrists lamed from holding the machine in its course, being carried away by admirers after the race.



The marvelous mechanism of the *Mystery 5*. The car is capable of 65 m.p.h. in first speed, 175 in second and 207 in third. The two engines,

back and front, must be synchronized before the main clutch can be used, and if they are not operating at the same speed the car will be wrecked.



This luminous jellyfish, found in the Sargasso Sea, is one of thousands of creatures that illuminate the ocean. The beautiful corona, or halo, is thrown by its own living light.

Science Reveals Secrets of "Cold Light"

*Studies of Luminous Insects, Fish and Bacteria May
Yield Key to More Efficient Lighting of Our Homes*

By ELLSWORTH BENNETT

SCIENTISTS are on the verge of far-reaching discoveries which eventually may make the incandescent electric light as out-of-date as the old-fashioned kerosene lamp. They are learning the secrets of a lighting system used by Nature for ages, yet always a mystery to man—the production of light without heat.

In a laboratory at Princeton University, Dr. E. Newton Harvey, professor of physiology, recently utilized the materials employed by fireflies in the summer to flash their lamps, and by fishes in the seas' depths to light their lanterns to produce continuous "cold light." Doctor Harvey believes that science will be able soon to create these materials artificially.

At the United States Bureau of Standards in Washington, two other scientists, Dr. W. W. Coblentz and Dr. C. W. Hughes, have just succeeded in analyzing and recording the intensity of the light emitted by various luminous animals and plants. By studying the spectrum—that is, by dividing the light into the rainbow of various colors, or wave lengths, that compose it, they have demonstrated that

this "living light" is virtually a hundred percent efficient in its radiation. In comparison, our best electric lamps, wonderful as they are, are woefully wasteful. In the laboratories of some of the larger electrical companies, still other experimenters have made lifeless substances glow without heat under strange invisible rays.

Since the beginning of time men have produced light by heat, by burning substances such as wood, tallow, oil or gas. The higher the temperature, the brighter the light. In the modern electric lamp we use electrical energy to heat a metal filament to the highest possible temperature and make it glow.

The incandescent lamp, marvelous invention though it is, shares with every other form of hot light the drawback that most of its radiation is in the form of heat, and not light at all. Less than two percent of it is visible light. The rest is wasted for the reason that the heat cannot be separated from the light.

Luminescence, or living light, on the other hand, contains nothing but visible light, as Doctor Coblentz's experiments

have proved. The firefly's light is all light. It is fifty times as efficient in light radiation as the finest incandescent lamp!

The glow of living creatures is only one of several different kinds of cold light, produced in widely different ways. Place your hand under a strong electric lamp, and your arm and finger nails will give off a glow. This glow is not reflected light, but is actually produced in the skin and nails. If the lamp light can be screened from view, the strange glow will become visible. Your hair, teeth, eyes, or almost any other part of your body can be made to give off similar light. This is fluorescence. It is explained by the theory that the body tissue has the mysterious faculty of converting rays of one wave length into rays of another wave length.

LIGHT, as we commonly know it, is simply the part of radiant energy visible to our eyes. In common with radio, X-rays, ultra-violet rays and other forms of radiation, it consists of ether vibrations, or waves. The differences between all of these lies simply in the length of their waves. Thus, the wave lengths of

ultra-violet rays and X-rays, for example, are shorter than those of visible light while heat waves and radio waves are longer. The different colors of the rainbow vary in wave length, too, from the shortest waves of violet to the longest waves of red.

USUALLY in fluorescence, short wave lengths are converted into longer wave lengths. Thus, many substances, including silk, wool, bone, horn, and numerous kinds of living matter, have the ability to convert invisible ultra-violet light, which has extremely short wave lengths, into visible fluorescent light.

Dr. R. W. Wood, of Johns Hopkins University, Baltimore, recently gave a spectacular demonstration of this kind of fluorescence. He directed ultra-violet rays from a filter lamp into a vessel containing nesculin, a substance extracted from the bark of the horse-chestnut tree. Immediately the solution shone with brilliant greenish-blue light. So vivid was its illumination that a photographer, by its light, was able to take the picture of Doctor Wood reproduced here. Other substances exposed to the rays produced glows of varying tints.

In somewhat similar fashion Dr. W. D. Coolidge, of the General Electric Company, inventor of the improved cathode ray tube, has made rocks, crystals and other substances glow with beautiful lights after exposure to cathode rays, produced by streams of electrons.

Sometimes substances will continue to give off fluorescent light after they have been removed from the "exciting" light. In certain cases they continue to glow for hours. This persistent light is called phosphorescence.

A faint cold light may be produced by rubbing two lumps of sugar together so as to crush the sugar crystals. A similar light appears if you shake crystals of ammonium nitrate in a tube. Every time the crystals hit each other a little flash of light is produced. This is called triboluminescence. Again if you take a roll of electrician's adhesive tape and rapidly strip off the tape, a faint glow will appear at the instant the tape breaks away. The light is believed to be caused by the rubbing together of minute crystals on the tape.

Certain chemical mixtures, too, produce heatless light. Thus, if to pyrogallol acid—the familiar "pyro" used by photographers in developing negatives—you add hydrogen peroxide and a small quantity of potato juice or animal blood the mixture will become luminous. This is known as chemiluminescence.

BUT it is in "living light" produced by animals and plants that scientists see the greatest possibilities for future usefulness. Some of these luminous creatures use lamps ingenious almost beyond belief.

In Doctor Harvey's laboratory at Princeton you can see a glass jar half filled with small grayish crumbs resembling birdseed. Once these crumbs were tiny crablike creatures called *Cypridina*

living in sea water near Japan. They carried little lighting plants in their bodies which made them glow. Now they are dead and dried. Yet today these dry crumbs, moistened with water immediately give flashes of bluish-green light. There is no burning, no heat. The strange source of light seemingly is undying.

On the earth, in the sky, and in the sea are countless other living things that manufacture light. Passengers on ocean liners often see the sea apparently burst into a vivid glow when stirred by the passing ship. This light, commonly

referred to as "sea sparkle," is produced by a small squid which, when danger threatens, squirts a luminous substance into the sea water.

THERE are marine worms that turn on their lamps when attacked, luminous sponges, jellyfish, earthworms, centipedes, starfish, glowworms, slugs, crabs and many others. They number tens of thousands. In all, at least forty orders of animals include one or more forms capable of producing cold light.

A large number of deep-sea fishes are equipped with lamps that resemble sur-

prisingly man-made searchlights. There is a double convex lens for directing the light in a beam. Back of the lens is a layer of cells containing shiny material which acts as a reflector. The light, produced in the center of the organ, is thrown against the reflector which shoots it out through the lens in a concentrated beam. And some of these light-producing organs are fitted with color filters which allow only light of certain wave lengths to pass, thus producing a definite color. One deep-sea cuttlefish, for example, possesses luminous organs of at least three different colors—blue, violet, and reddish. A certain South American insect called the automobile bug, conveniently enough has a white light at its head and a red light at its tail.

The plant world, too, contains at least two light-making forms. No doubt you have seen damp wood glow at night. This "fox fire" is produced entirely by fungus in the wood. Or perhaps you have seen meat or fish in a refrigerator glow in the dark. This faint light comes from microscopic luminous bacteria. The fungus and bacteria both are plants.

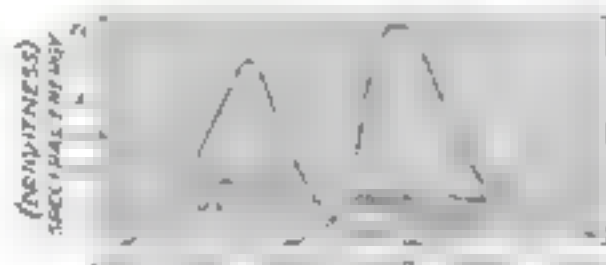
Oddly enough, the bacteria, smallest lamps in the world, have proved the most useful in the study of living light. Bacteria give off light continuously, and colonies of them can be kept alive indefinitely. Doctor Harvey not only has measured the intensity of their light, but actually has computed the efficiency of their lighting mechanism. And this despite the fact that the bacteria are so small that 2,000 of them, placed side by side, would barely fill an inch. The light of a single one of them cannot be seen even under a microscope. Only when thousands are together is their illumination visible. It takes 50,000,000,000,000 of them to equal one candlepower of illumination.

DOCTOR Harvey measures their light by making an emulsion of billions of the bacteria in sea water. Then he counts the number in each cubic centimeter, measures the light emitted by one cubic centimeter, computes the light which they absorb from one another and so calculates the light which each individual would send in all directions if there were no absorption. By measuring the food and oxygen consumed by the bacteria in relation to the amount of light energy produced, he estimates their over-all efficiency as

(Continued on page 118.)



The only light used in taking this remarkable picture was the greenish blue glow from a substance in horse chestnut tree bark when exposed to ultra violet rays. The photograph shows Dr. Robert W. Wood, physicist, of Johns Hopkins University, one of the scientists seeking to copy Nature's methods of light production.



Spectrum chart showing two typical luminous creatures a hundred percent efficient in light radiation. All of their radiation is in the visible part of the spectrum; in other words, none of their rays are lost in heat beyond the red end, nor in invisible rays beyond the violet end.

called phosphorescence, comes from millions of light-making animals, most of them so small that they can be seen only with a microscope. And in the depths of the ocean are strange fishes that dangle gleaming lanterns from long stalks projecting from their heads; others with rows of lights along their sides, like a ship with lighted portholes.

In the waters of Japan lives a squid that brandishes lamps on the ends of its tentacles. As it swims it waves these lanterns, flashing them on and off. The Japanese call it the "hotaru-ko" or "firefly squid." Living in perpetual darkness in the depths of the Mediter-



Col. B. D. Foulis, commandant of Mitchell Field, center inspecting the *Sea Hawk*. Its nine cylinder engine is of the air cooled type.

New Plane Stops Like an Auto

"Sea Hawk" Rivals the Birds in Speed Range and Control

ONLY six feet of air separate the plane from the ground. Motor roaring, it flirts with the earth. Gracefully, lazily, it skims closer, throttled so slow that a fast motor car could outdistance it. It touches, rises again, wheels spinning from the contact and airily circles the field. Now it lands. Rather, it "sits down." Instead of bumping for many yards along the ground, it glides to earth and stops within a few feet!

This was the first public test, the other day at Mitchell Field, N. Y., of a remarkable new fighting airplane, the *Sea Hawk*, built for the U. S. Navy. The plane's ease of maneuvering at slow speed and its hydraulic wheel brakes indicated that it could land directly upon the deck of an airplane carrier.

Yet when its 425 horsepower motor is opened up, the plane achieves a speed of 170 miles an hour. The *Sea Hawk* is called the fastest plane in the world equipped with an air-cooled motor.

Embodied in its construction are a thrust-back lower wing, enabling the pilot to see his landing gear; shock absorbers, staggered wing construction,



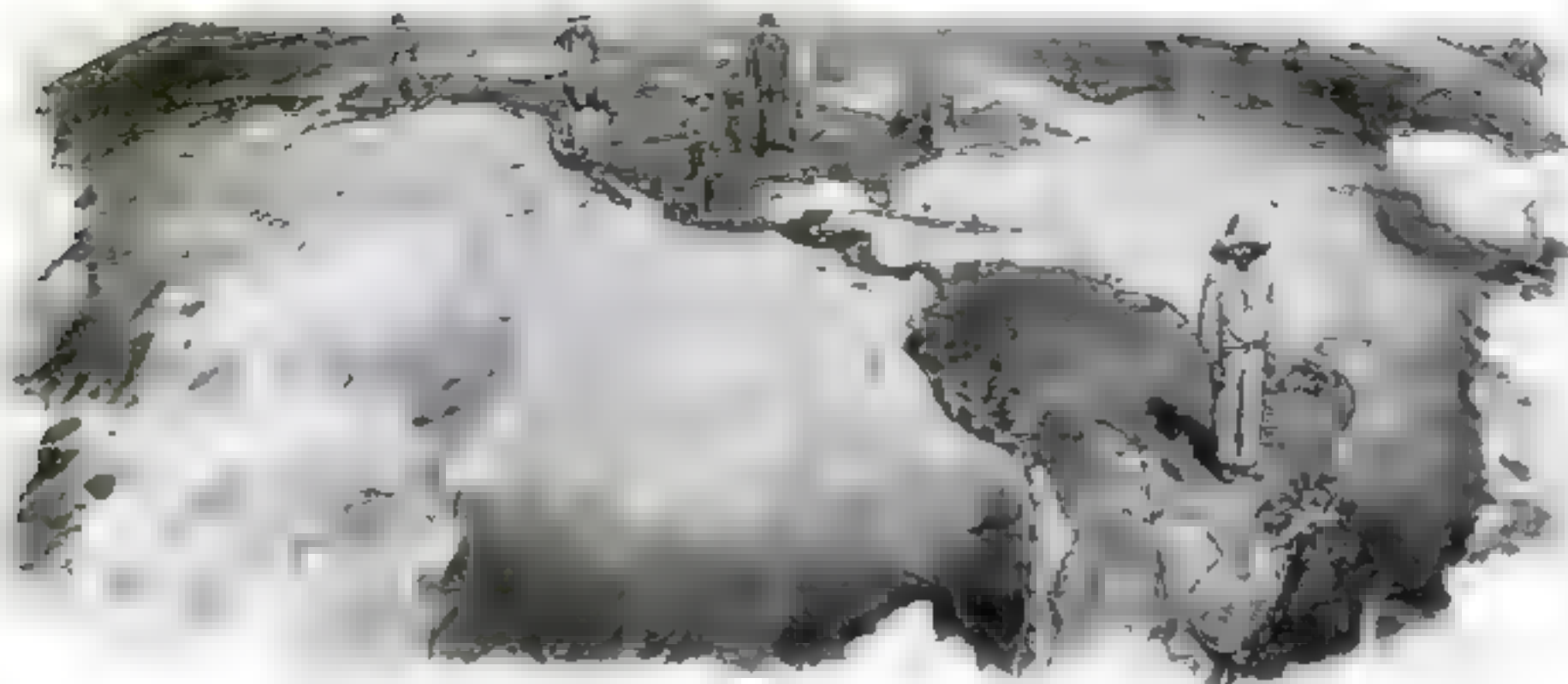
T. N. Joyce, test pilot, and the new plane. The wheels are equipped with hydraulic brakes, operated as in an automobile. It also has shock absorbers



Spectators gasped as the *Sea Hawk* performed these dangerous feats. Upper photo, "standing on a wing tip" while making a turn. Lower photo, touching wheels to ground and rising in air again.

and curved upper wing, to avert danger of the deadly tail spin. It can be converted in a few minutes into a seaplane by the addition of pontoons. Under the cowling are two machine guns, which fire through the propeller. Neat lettering on various compartments along the fuselage show the location of the engine crank, log book, fire extinguisher and tools.

Novel safety devices—features usually sacrificed to speed and maneuverability in fighting planes—are provided. A button in the cockpit, in case of fire, squirts extinguisher fluid on the engine. A valve empties the gasoline tanks into the sea in an instant. And a rubber lifeboat is within reach of the pilot, provided with bottles of liquefied carbon dioxide gas that inflates it in six seconds, and small oars for paddling, if the plane should fall into the ocean!



The pairs of figures above indicate by their comparative sizes the populations that will be supported eventually by different regions. North America will support 600,000,000, of whom 200,000,000 will be in the United States. The equatorial regions will be densest.

City Populations Predicted from Study of Flies

*Experiments with Pumpkins, Yeast and Rats
Make Possible Forecasts of Cities' Growths*

By MYRON M. STEARNS

THEY were weighing a rat in one of the research laboratories of Johns Hopkins University at Baltimore. Weighing it with particular care, for a strange reason—to find out what the population of New York City would be in 2000 A.D.

The study of a rat's growth came in the course of an investigation by Dr. Raymond Pearl, Director of the Institute of Biological Research at Johns Hopkins, by means of which he has demonstrated that the increase in population in a given region or country over a particular period of time can be foretold with almost unbelievable accuracy.

For seven years Dr. Pearl has been studying population growth. The first observations were made with a pumpkin, which like all other living multicellular organisms, grows by the division and reabsorption of its cells. A single cell reaches the limit of its size, then splits across the middle and becomes two cells. At first it looks as though the process could go on forever, with the pumpkin getting bigger and bigger. But Dr. Pearl discovered that at first the pumpkin grows rather slowly. Then the rate of increase becomes much more

rapid. Finally, after it reaches maximum speed, it begins to slow down again, the slowing down rate almost exactly reversing the acceleration. The division of cells becomes less frequent, until the pumpkin, reaching full size, stops growing.

The investigation shifted to the tail of a tadpole. If a tadpole loses its tail it promptly grows a new one. Doctor Pearl wondered if the growth of a new tail, speeded up by Nature to meet the emergency, was similar to the normal growth of a pumpkin.

They found it was. As in the case of the pumpkin, the new tadpole tail began to grow slowly. Then the rate rapidly increased, the single cells that composed it dividing faster and faster, until a maximum rate of growth was reached. After that the process slowed down as the tail approached full size, and then stopped altogether.

THEN there was the rat, and again the growth tallied with those of the pumpkin and the tadpole's tail. Rat, pumpkin, and tadpole tail, however, all differ in one respect from any growth resembling that of population. The new cells re-

main the whole rat or the whole pumpkin. But Dr. Pearl was endeavoring to trace a similarity between the growth of the rat, the pumpkin and the tadpole tail in an effort to establish that the seemingly haphazard increase in the number of people in the world in reality follows similar fixed laws. To come a step nearer to the growth of a human population, an experiment was next tried with fruit flies—microscopic organisms that can fairly be compared with a human population in their independence of action and response to environment.

TWO fruit flies were put into a half-pint bottle with a quantity of banana-agar, a gelatinous food supply sufficient to nourish a whole fruit fly army. The female laid her eggs, the eggs hatched, and soon the bottle was teeming with population. Regular counts were taken to note the rate of increase. As the population grew, the rate of increase grew with it. Then, with the bottle becoming too crowded, the increase slowed down and finally stopped altogether. The fruit fly world embodied in the half-pint bottle had all the population

Invents Amazing Electric Relay

Engineer's New Control Tube Runs on a Billionth-Watt

A GOLD watch lay on a plush-covered table in a New York hotel. Near by was a small glass bulb. A man extended his hand to the watch, but even before he could touch it, an electric alarm rang.

A lighted match was held between the thin wires connected with the bulb. The bell rang again. The same thing happened when a drop of water fell on the wires, and again when the window shade was raised, admitting sunlight!

These magical happenings were demonstrations of a new relay instrument, said to be the most sensitive of its kind ever made, the invention of D. D. Knowles, 28-year-old engineer of the Westinghouse Electric and Manufacturing Company. A relay is a device that controls a large electric current by a much smaller one. The Knowles "grid glow" will respond to a billionth of a watt, or one fortieth the energy exerted by a fly combing an inch of the wall! It can magnify electric power a hundred million times, compared with the ten thousand times of the ordinary relay.

While its chief use will be in the auto-

Below the grid glow relay
is at work in the
the relay is in the
D. D. Knowles, at the time



matic control of electric machinery and devices, the relay can also be used to turn lights on and off automatically to count people, automobiles or products passing a given point, and to protect valuable exhibits in stores and museums.

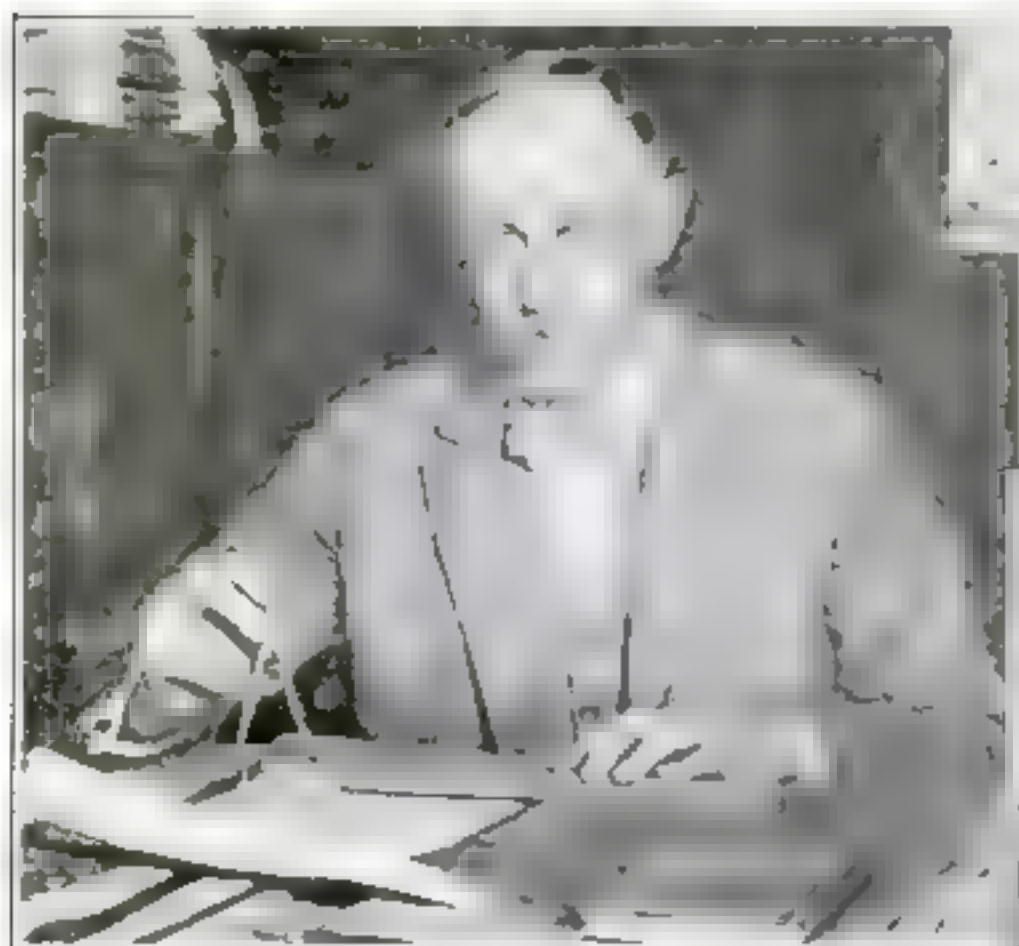
The bulb is gas-filled and, like a radio



When a small amount of water is poured on the wires, the relay is in the

ture contains two electric poles and a grid (small) in between. The poles are connected in the circuit to be controlled. Between them the charged grid acts as a gateway or blockade against the flow of current. When some minute outside influence, such as the movement of the hand in reaching for the watch, draws the charge from the grid, the gateway opens and the current flows, operating the bell.

Longest Power Transmission Near

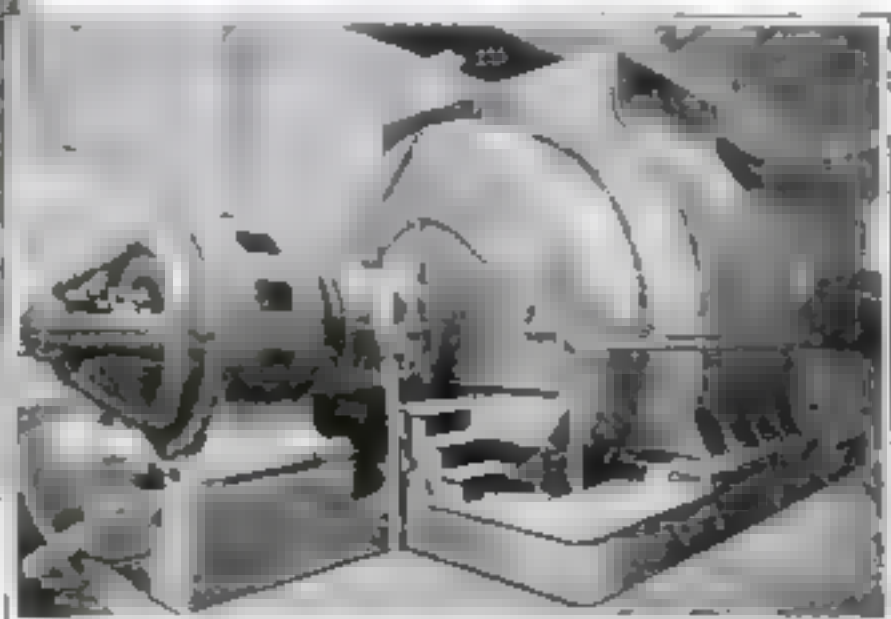


Frank G. Bausch, San Francisco engineer, whose tertiary synchronous regulator equipment is hailed as one of the most important inventions ever made in the handling of electricity. At right a photo of the apparatus.

CALIFORNIA is by far all the way in the world in the power transmission business. It has a record of 2,300 miles of lines, which is more than any other country. The first line was built in 1890, and the last in 1925. The system is now the largest in the world, and it is still growing.

The system is now the largest in the world, and it is still growing. The system is now the largest in the world, and it is still growing.

The system is now the largest in the world, and it is still growing. The system is now the largest in the world, and it is still growing.



Forty-Niners of 1927

*Motor Cars, Airplanes and Modern Machinery
Mark Latest Stampede for Gold in Nevada*

By EDWIN KETCHUM

EARLY this spring two nineteen-year-old boys, prospecting in the barren hills of Esmeralda county, southwestern Nevada, ran upon a badger hole. They dug into the hole. At the bottom, instead of a badger, they found a ledge of rocks shot with streaks of gold. The boys staked a claim and carried samples to Tonopah, thirty miles away. The rock assayed enormously rich—\$78,000 a ton.

That was the beginning of the new gold rush at Weepah, Nevada, which has spread its fever up and down the California border and ushered in a new romance of treasure.

The two boys, Leonard Traynor and Frank Horton, Jr., dug up chunks of rock streaked with gold in ribbons half an inch wide. News of the find traveled swiftly. Prospectors, merchants, clerks, financiers and tourists drove across the sagebrush to Weepah in thickening clouds of dust. There was a scramble for claims. Other lucky strikes followed. Ed McKelvey, veteran miner, strolled in from the hills with surface gravel valued at \$50 a pound. Pine Nut Johnny, a Poute Indian, brought news of another rich find at Bartel Springs, five miles away.

Within two weeks a forest of claim stakes sprawled over some 4,000 acres of desert, and a lifeless stretch of sage brush and sand had been transformed into a mining camp of tents and shacks. Claims brought as high as \$50,000.

Today the gold fever is raging along a thousand-mile front from Phoenix, Arizona to Oregon and Washington. Goldfield, Nevada, scene of a great rush of two decades ago, experienced a sympathetic boom. In the Arizona desert a race of motorists began when two oil-liners, Dan McEraw and James Girard,



Dig your fist into rocky soil at Weepah, Nevada, and you may pull out a handful like this! A hundred dollars' worth of gold was panned from it.

told of a pay streak averaging \$100,000 a ton in the hills near Drapping Springs. In California another rush centered in the Rand district, near Bakersfield, a region of deep mines which have produced millions of dollars in gold and silver. Similar symptoms appeared as far north as Walla Walla, Wash., where J. D. Walter, a butcher, found six gold nuggets in the crops of two chickens.

EXCEPT that the old spirit of adventure and the thrill of gambling for big stakes are there, this new stampede is far different from the famous gold rushes of the past. For in the three quarters of a century since the California madness of 49, even in the quarter century since the hectic days of the Klondike, Tonopah and Goldfield, mechanical science and electricity have wrought mighty changes. The prospector's slow-moving burro has surrendered to the flyer, the roadster, even the airplane. Electric lines are projected to supply the new mining camp with light and power. For a time the prospector's pick, shovel and pan may serve to locate "pay streaks," but soon

hand tools must give way to blasts, electric drills and modern mining machinery.

For in the part of Nevada where Weepah lies, most of the precious yellow metal is hidden in rocks—in deep-running veins of quartz, or lode. Unlike the placer deposits of early California or the Yukon, where miners washed golden dust from the gravel of streams, the Nevada treasures must be recovered by sinking deep shafts and running levels and drifts to follow the lode. Electric hoists must raise the quartz to the surface. Other machinery must

crush the rock to powder and from it extract the gold by washing and other metallurgical processes. This is known as quartz mining, as distinguished from placer or hydraulic mining.

At Tonopah, Goldfield and other workings, veins of quartz have been followed for thousands of feet. In the famous Comstock lode, shafts were sunk so deep that miners were able to work only an hour or so at a stretch because of the unbearable heat.

Vein mines such as these gradually are "worked out" and abandoned. Then it often happens that some lucky prospector stumbles on a rich new vein where it crops out near the surface, just as did the two boys exploring the badger hole.

NO ONE knows for certain just how the veins of gold-laden quartz came to be in the rocks. Geologists generally believe that in ages past deep subterranean streams carried sand and gold in solution under terrific heat and pressure. During one of nature's upheavals these waters geysered up, filtering through cracks and fissures in the earth's crust. There they crystallized into quartz, and the



Scene at the gold rush camp at Weepah. The "lucky strike" was made in a low hill overlooking the camp, which originally had only four frame dwell-

ings. Spreading like wildfire, the news brought a population overnight, to transform the desert spot into a place of tents, shacks and automobiles.



The two boys who, while prying over a log, first found the strike that started the Weepah rush. Right: left, Frank Horton, Jr., Leonard Traynor and young Horton's father.

gold with it, fishing crannies between rocks and then turning over logs.

An unusual feature of the Weepah strike, say the old timers, was the discovery by Ed McKelvey of rich gravel or placer deposits on the surface. In addition to the lode. The presence of this "pay dirt," they declare, has caused trouble in the new mining camp, for under the state laws provision for placer mining, the lode placer claim areas already staked out for quartz or lode mining. Thus two classes of claims may be filed on the same area, the placer miner being entitled to all the gravel down to the regular lode.

The great placer discoveries, such as those of California and the Klondike, usually have been along streams. Through the ages, as mountains have been worn away by the elements, particles of gold have been washed with the soil into streams. The metal sinks to the river bed, the lighter material being carried away.

AS STRANGE and romantic as the story of the Weepah badger hole have been the histories of the richest placer finds. The stampede of '49, for example, was ushered in by two men engaged in the prosaic work of building a sawmill on the fork of the American River, near the present site of Sacramento, Calif. One of them, examining the tail race of the mill, was attracted by a glitter in the sand at the bottom. Within a year hundreds risked

hardship, danger and death to explore neighboring streams. Fifty years later the story was repeated in the Yukon, when men braved the Alaskan wilderness to sift gold-en gravel from the Bonanza, Fairbanks and other treasure-filled creeks. In a single year they won \$22,000,000.

The heaviness of gold which has settled on stream beds is the quality which men have employed to advantage in developing methods of placer mining, in which the gold is separated from the gravel by washing. The simplest method, and the one widely used in early days when surface gold was comparatively common, is known as panning. The prospector fills a

the gold at the bottom. The gold is finally recovered by further washing or "panning out." The pan is used now only in prospecting.

An elaboration of this method was the "cradle" used to wash "pay dirt" in larger quantities. This was a box, mounted on rockers and fitted with a perforated bottom of sheet iron. While water was poured over it, the cradle was rocked, causing the pay dirt in it to sift through or to an incline stripped with bars of wood called "riffles," to catch the gold.

IN LARGE scale placer workings the most effective methods have been sluicing and hydraulic mining. The sluice is a shallow inclined trough through which a stream of water is directed. When the pay dirt is shoveled into the upper end of the trough, the gravel is carried downstream, while the heavy gold settles and accumulates on the floor of the trough, which is laid with riffles. Hydraulic mining, or mining by water pressure, is used to recover free gold from large gravel beds. Powerful streams of water tear away the gravel and carry it into sluices.

For working gold bearing river beds, huge bucket dredges have been used extensively in the West. The gravel, dug by the dredge, is put through screens, and the finer material passes to sluice boxes provided with riffles.

In these last three processes mercury has been employed to aid in capturing the gold by amalgamation, the mercury later being removed by distillation.

Dry gravel beds where once a river flowed are the chief hiding places for those treasured lumps of gold—nuggets—which are the dream of every prospector. One of the most famous of them, the "Welcome Nugget," was picked up at Ballarat, Australia, half a century ago by a penniless fortune hunter. It weighed 185 pounds and was valued at more than

\$50,000. The largest nugget ever recorded was discovered at Hill End, in New South Wales. It was about five feet long, three feet wide, and four inches

thick and sold for \$148,000! Scientists believe nuggets have been formed by the massing together of smaller grains of gold in the rough and tumble of time. In placer deposits the richest treasures ordinarily are found at the bottom of the gravel beds close to the bed-rock. Sometimes, when the gravel beds are unusually thick, shafts and tunnels must be built to reach the best pay dirt. These are known as tunnel claims.

As alluring as nuggets are the fabulously rich veins occasionally opened up in the quartz deposits. The "lucky strike" at Weepah is a shining example. Here is a district that has been mined, off and on, for

(Continued on page 138)



"Seldom Seen Slim," familiar figure in the busy busy Weepah camp, places a monument on the claim he staked.

shallow pan about two thirds full of "pay dirt." Then he holds it in a stream and shakes it in such a way that the water carries away the lighter material, leaving



Pitching a tent on the road to El Dorado: Gold seekers who have raced by automobile to the remote corner of the Nevada desert, resting up before searching the barren hills that may give reality to their dreams of wealth.

An Amazing Vision of the Future

Scientist Foresees a World Run by Radio

By ROBERT E. MARTIN

THE present is only the very beginning of an age of discovery—and the next century will mark the greatest advance of civilization in the world's history. So says Prof. A. M. Low in his new book, "The Future," a tale of wonders such as no fairy tale ever presented, of the marvels science has in store for the future. Professor Low, British scientist, depicts a future more fantastic than anything most of us could imagine.

The typical man of the future, he thinks, will be called by a radio alarm clock in the morning to take a few moments' radio legat treatment or massage. Then he will jump into his syzygetic felt one-piece suit. He will wear his hat almost continuously, because everyone will be bald. He will have to watch out lest he put on his wife's clothing by mistake, for men and women will dress almost naked.

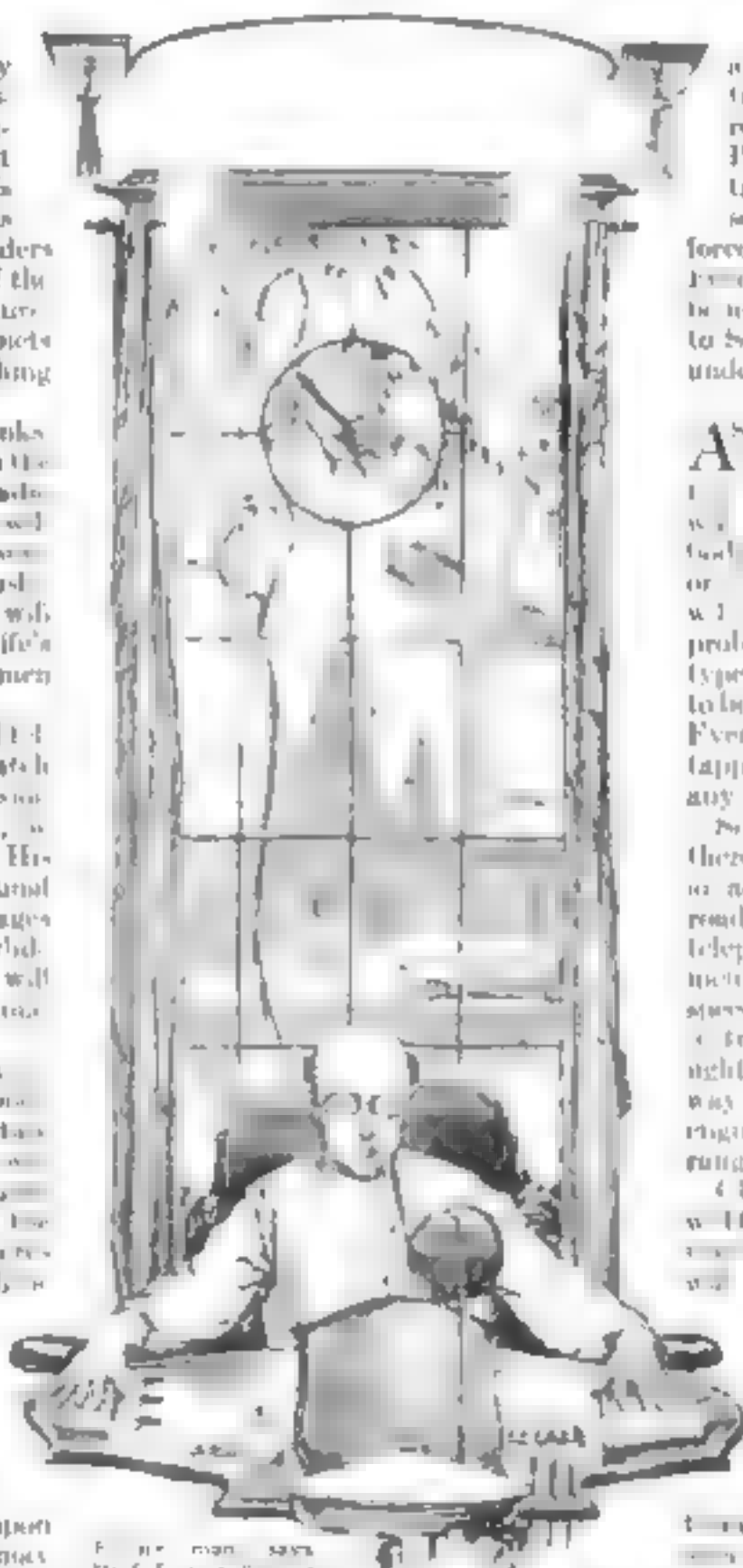
During breakfast a loud-speaker will tell him of news events, and he will watch some of them as they occur on a television screen. By altering the wave length, he can hear the kind of news he wishes. His breakfast may come from the communal kitchen by tubes. Telephone messages that were automatically recorded while he slept will then be read, and so too will the news received on his radio tape recorder.

The business man of the future, traveling to his office in his car, will get in touch with it on the way by radio and dictate to a pocket dictaphone. An elevator will carry the car to his floor. All other buildings will have moving stairways, the streets moving sidewalks and the stores on a flying floor. Most of his travel will be by air, and he will weekend in Africa or Australia.

The world as lives in will be much quieter than it is today, for noise will have to be eliminated before long. Already there is proof that noise raises the temperature of a room and has a destructive effect upon machinery. Even noisiness subways may be attained. Professor Low says, London already has a type of underground train in which you can hear a watch tick, the cars having asbestos-filled roofs, special windows, and hoods over the wheels to deflect noise.

THIS soundless world may be lighted at night by radio oscillation, for wireless has many of the characteristics of light. There will be stations to broadcast light, which all buildings will tap as required.

Future man will carry a pocket radio set everywhere he goes, and television will make long-distance business conferences possible. It will also make it possible for



Future man, says Prof. Low, will wear syzygetic felt suit, and his hat almost continuously.

schools to link up, hearing and "seeing" the same university lecturer at the same time and following the lecture by diagram upon a wireless-controlled blackboard.

In its earlier stage of development, as Professor Low visions it, radio power will be distributed locally from cables under the principal roads, and vehicles will pick up the power through their motors. Factories will be built in the country and run by power broadcast from huge stations.

But all this is nothing to what may be

accomplished by control of the electronic emanations. "If matter is the result of defined electric vibration," Professor Low asks, "could we not transfer our tables, our chairs and ourselves, in effect, by a knowledge of the forces which produce these oscillations?" Future man may watch a bale of goods being whirled through space from Europe to South America, traveling, so to speak, under its own power.

AS FOR the automobile, it will give man service and thrills that the automobiling industry today does not dream of. It will be a stream-lined car with flexible body, enclosed in flexible glass, with four or six disk wheels shrouded. The interior will be air-cushioned. The engine will probably be of a gasoline steam turbine type, totally enclosed, and will not have to be tinkered with more than once a year. Eventually, power for vehicles will be tapped from the air by beam-wireless at any time or place.

Some day, too, Professor Low predicts, there will be a wonderful Pegasus vehicle, an aerocar, that can fly as well as ply the roads. It will be equipped with a radio telephone and loudspeaker, a mileometer, hydrometer, barometer, aneroid, speedometer and thermometer. Control instruments will be easily operated with a light touch and gear changing will give way to automatically variable gears or to engines which can give power over a wide range of speed.

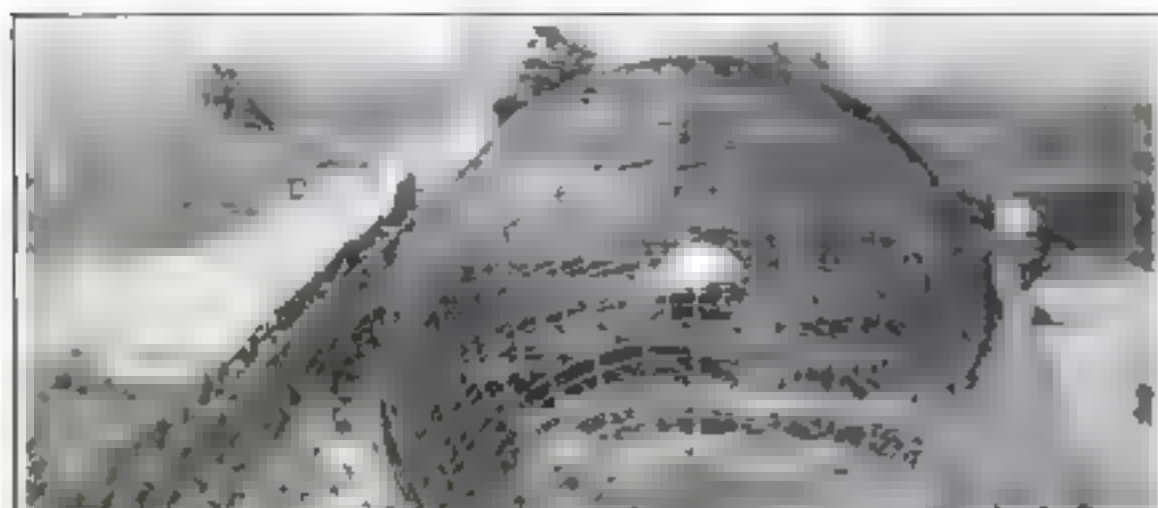
Chemistry's great immediate future will be among the uses of atomic disintegration, and Prof. Low sees no doubt that we will be able to construct synthetically more and more materials used in everyday life today as direct products of nature.

Greatest marvel of all, perhaps, will be the transfer of power to the Earth from other planets. This is quite possible, Professor Low thinks, and he sees nothing fantastic in the use of interplanetary communication. Light signals from a super-searchlight beam thrown by ten thousand giant calcium flares and reflectors, developing a light of two million billion candlepower, might span the 35,000,000 miles that separate Earth and Mars when they are nearest, or it may be done through wireless, for the most powerful transmitting station is believed capable of reaching the Moon.

"It is far from fantastic," he says, "to believe that in our near future as knowledge of this wonderful force improves, it may be possible to span the distance by sending directional waves or combinations of waves, of enormous strength."

"There is no limit to the adventure of man into the terrific realms of science!"

The Progress of Aviation



An amazing propellerless all metal airship is being built by Thomas Benson Slaters, well known engineer at the Glendale airport. Craft planned on entirely new principles, it will be neither pushed nor pulled through the air but will float by air pressure from behind. A radial blower in the ship's nose will create a slight vacuum in front of the dirigible and pressure from behind constantly pushing the ship forward and this will up. The hull upon envelope will not be divided into sections but will come out one great oval gas bag. The whole plan can plan to 1000 ft. The new airship proposed to be built at the left will be entered in competitive building by Government engineers.



Thomas Benson Slaters building a new dirigible at Glendale, Calif. Slaters will compete.



Wing span 14 ft. 6 in. 105
Wing area 150 sq. ft. 250 sq. ft. 105



Called the world's largest land-flying machine, his giant biplane at Me. Valerien, near Paris, carries airplanes at night on the London-Marseilles route. Revolving beams from its twin sets and a half-foot reflectors are visible ninety miles away and the light of a sodium searchlight is thrown out from them through space.

Long Commander Noel Davis, of the U. S. Navy, is this summer's New York air show for the \$5,000 prize. Davis is a pilot who has seen the large ship to be used in his fleet. Davis is a sketch of the giant biplane, Pathfinder, being built into. A most unusual feature is the huge gasolene tank holding 900 gallons of fuel in the fuselage compartment. Its weight instead of being divided, as is usual with large planes, thick wings give the plane unusual lifting power.

Californian Builds Propellerless Dirigible—Latest German Super-Ship—Ninety-Mile Beacon for France—Other Advances

At night, however, the dirigible is used as a floating lighthouse. The large Junkers dirigible, which is being built by the German government, is the largest of its kind. It is 240 feet long, 40 feet in diameter, and has a capacity of 100,000 cubic feet. It is built of aluminum and is capable of flying at a speed of 115 miles an hour.



Left: Power plant of the dirigible, showing the engine and the propeller. The engine is a large, dark, cylindrical object, and the propeller is a large, circular object. The right: A view of the dirigible, showing its long, narrow body and its small, rounded nose. The dirigible is shown in flight, with several figures visible on its side.

The dirigible is built of aluminum and is capable of flying at a speed of 115 miles an hour. It is 240 feet long, 40 feet in diameter, and has a capacity of 100,000 cubic feet. It is built of aluminum and is capable of flying at a speed of 115 miles an hour.



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The Lexington, newest American airplane carrier, receiving a coat of battleship gray at the Fore River shipyards, Quincy, Mass. Two new airplane carriers will be added to Uncle Sam's

naval defense forces with the completion this fall, at the Fore River yards, of the Lexington and the Saratoga. Both the ships will be equipped with the latest landing and take-off devices.

How Sea Flying *Was* Made Safe

The first hydroaeroplane—Ship-to-shore flights—Other triumphs of Glenn Curtiss, air pioneer

By

FRANK PARKER STOCKBRIDGE

ENTHUSIASTIC delegations met Glenn Curtiss at the pier when he returned from Europe. His victory at the first international aviation meet in France had fixed him as a national hero.

All America now wanted to see him fly. Scores wanted him to build flying machines for them. The Curtiss Company had been enjoined by the Wrights against selling airplanes. Curtiss had to get money to fight the patent litigation. The quickest and easiest way was by giving exhibition flights.

That summer of 1910, the city of New York staged a double celebration, the three hundredth anniversary of Hendrik Hudson's discovery of the river and the centennial of Robert Fulton's voyage in his first steamboat. The promoters planned a great procession up the Hudson. Replicas of the Half-Moon and the Clermont were to be conveyed by a fleet of aircraft. Popular imagination, fired by the amazing things already accomplished in the air, leaped fifty years beyond possibilities. Tremendous was the disappointment when the airships failed to perform according to promise.

Glenn Curtiss, keeping a promise which he had made before sailing for France, took a plane to Governors Island in the upper bay, and waited for favorable winds.

A CANNON shot was to be the signal for the start of his flight. But so many cannons and bombs were being fired that few paid attention when, at last, he made a short flight in the direction of the Statue of Liberty and returned to Governors Island. He had an engagement for an exhibition flight at St. Louis and had to hurry away without competing for the prize of \$10,000 which the *New York World* had offered to the first airman to fly over the route of Hudson and Fulton, New York to Albany, or in the opposite direction.

A few days later Wilbur Wright flew his plane several miles up the Hudson River. "That was really a magnificent flight, considering weather conditions and the stage which flying had reached



Glenn Curtiss landing in New York City after flying down the Hudson from Albany. He covered the 152 miles in two hours and fifty-one minutes—one of the most significant feats recorded in this series of articles. The fourth of which is on these pages. Above: photo of the Langley medal, awarded Curtiss in 1914.

at that time." Glenn Curtiss said to me.

For exhibition flights Curtiss devised a "knockdown" airplane. The wings came apart in sections. Everything packed into compact cases, he could carry his plane as personal baggage anywhere. This was the machine he took to St. Louis, where tens of thousands saw an airplane in flight for the first time and cheered the evolutions of Captain Tom Baldwin, Roy Knabenshue and Lincoln Beachey in their Baldwin-Curtiss designs.

Then to Los Angeles, for the first international flying meet ever held in America. Louis Padian was there for France. Curtiss and his first pupil, Charles F. Willard, whom he had taught to fly at Mineola, were there.

New records were made for cross-country flying, for speed, for altitude. Louis Padian flew higher than anyone had ever gone before—4,165 feet!

THIS was in January, 1910. Glenn Curtiss got off the ground in six and two fifths seconds after a run of only ninety-eight feet. He won \$6,500 in prizes, for speed, for endurance, for getting off the ground in the shortest time. On April 10th at Memphis he clipped three fifths of a second off his Los Angeles starting time. At San Antonio, on April 23rd, he lowered that another tenth of a second. The next day, in the same place, C. K. Hamilton, one of the first of the Curtiss galaxy of flying stars, got off the ground in less than four seconds, with a run of only seventy feet.

practiced with it until manipulation of the controls became automatic.

In the three years following the crowning of Glenn Curtiss as king of the air at Rheims, more than two thousand exhibition flights were given by his pupils and himself. He neither sold the planes to those exhibition flyers nor employed them; the first would have further complicated the patent litigation of the Wrights, while the second would have made him liable for damages in case of accident. He taught his men to fly, then leased the machines to them; they took their own risks.

Extra hazardous risks, some of them, particularly the stunts which Lincoln Beachey insisted on trying. The newspapers reported that a Frenchman had looped the loop with an airplane; nothing would do for Beachey but to try it himself. What would happen when the engine turned upside down and the gasoline leaked out of the carburetor? That worried Curtiss.

"I CONFESS I don't know yet why he didn't set his machine afire when the gas flowed down over the hot engine," he said to me, "but somehow Beachey got away with it."

He was the dare-devil of the Curtiss flyers. His exploit in flying down the Niagara Gorge, over the boiling rapids, through unknown and treacherous air currents, was probably the greatest risk ever taken by an airman. Spray from the Falls, drawn in through the carburetor, fouled his spark plugs, and the en-



guns was hitting on only an occasional cylinder when he finally landed. The crash that ended his life a year or two later was inevitable to one of Beachey's temperament.

Wealthy sportsmen were beginning to buy airplanes. Curtiss' first private customer was A. P. Warner of Beloit, Wisconsin, inventor of the Warner speedometer. He built an aerial speed gage on the principle of an anemometer; four hemispherical cups, revolving on the ends of a Greek cross, the familiar method of measuring wind velocity. Warner gave one to Glenn Curtiss to try. One of the cups flew off and hit Curtiss in the face. He advised Mr. Warner to try another scheme.

Curtiss had not lost sight of that \$10,000 purse hung up for a Hudson River flight. Nobody had got it in 1909—the prize was still anybody's. All that spring of 1910 a new machine, specially designed to win the *World* prize, was going through the Curtiss works at Hammondsport.

In May Curtiss put pontoons on his new plane, flew around the Hammondsport valley and landed safely on the waters of Lake Kenka. The first hydro-aeroplane! Now he could undertake to fly the length of the Hudson River with assurance that he would not be drowned if his plane failed.

HE SPENT days preparing for the flight. Scouring for landing places along the route where he could descend for gas and oil in case of accident, he stopped at Poughkeepsie, halfway between New York and Albany. Here he found a splendid site, on the grounds of the State Hospital for the Insane.

When I told Dr. Fay of the superintendent that I intended to start here on my way down the river in a flying machine he said, very politely: "Why certainly, Mr. Curtiss, come right in here, I live where all flying machine inventors and pilots are, chucking at the same scene. That was the attitude, still, of everybody who had not seen an

airplane flying in the air.

His plane, the *Hudson Flyer*, was set up on Rensselaer Island, between Albany and Troy. Crowds came to see it. All the great newspapers sent reporters. The *New York Times* chartered a special train to race the airplane down the river whenever Curtiss should start. And Curtiss waited.

ON THREE different mornings he got up at daybreak, ready for an early start, then decided there was too much wind. He put in his time with his mechanics, tinker-ing while the impatient newspapermen openly accused him of being a faker. Editors all over the country printed gibes.

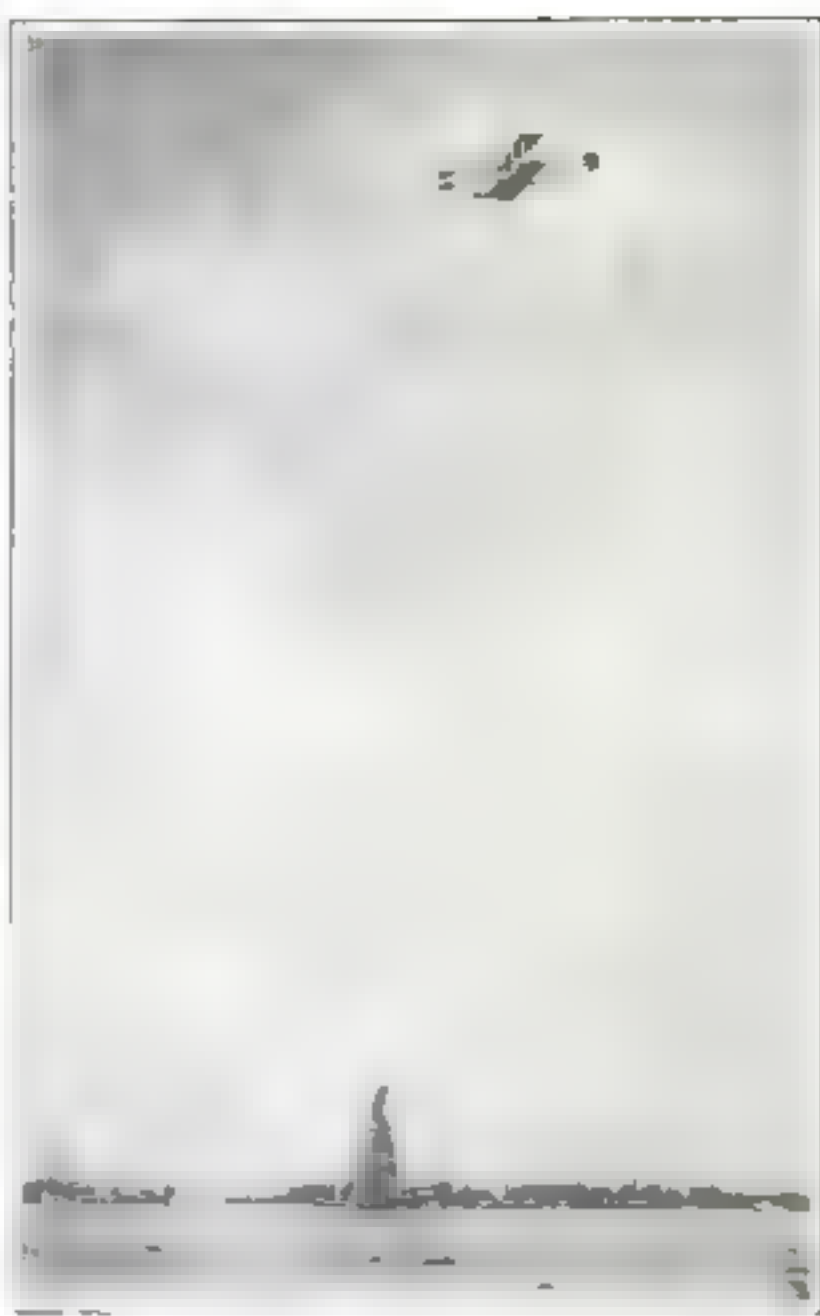
At last at dawn on the morning of May 30, 1910, Curtiss announced he was ready. The reporters flashed the news to their papers. Holiday crowds lined the river banks—and Curtiss didn't start! The weather at Albany was fine but the telegraph brought reports of strong winds blowing northward up the river. By nightfall of that Memorial Day the newspapers and the public were convinced that nobody would ever even try to fly down the Hudson. Then, the next day, Sunday morning, Glenn Curtiss started out and did it.

"I was getting as tired of waiting as anybody else," he told me.

It was just after eight when he rose into the air. The day was calm. His motor running perfectly. The special train started as he did, slipping down the water-level rails of the New York Central.

For Curtiss was a man of great nerve. No trouble to get the even more, notes

For Curtiss was a man of great nerve. No trouble to get the even more, notes



Circling the Statue of Liberty at the finish of the Albany New York flight. Curtiss had put pontoons on this plane, producing the first hydro-aeroplane.

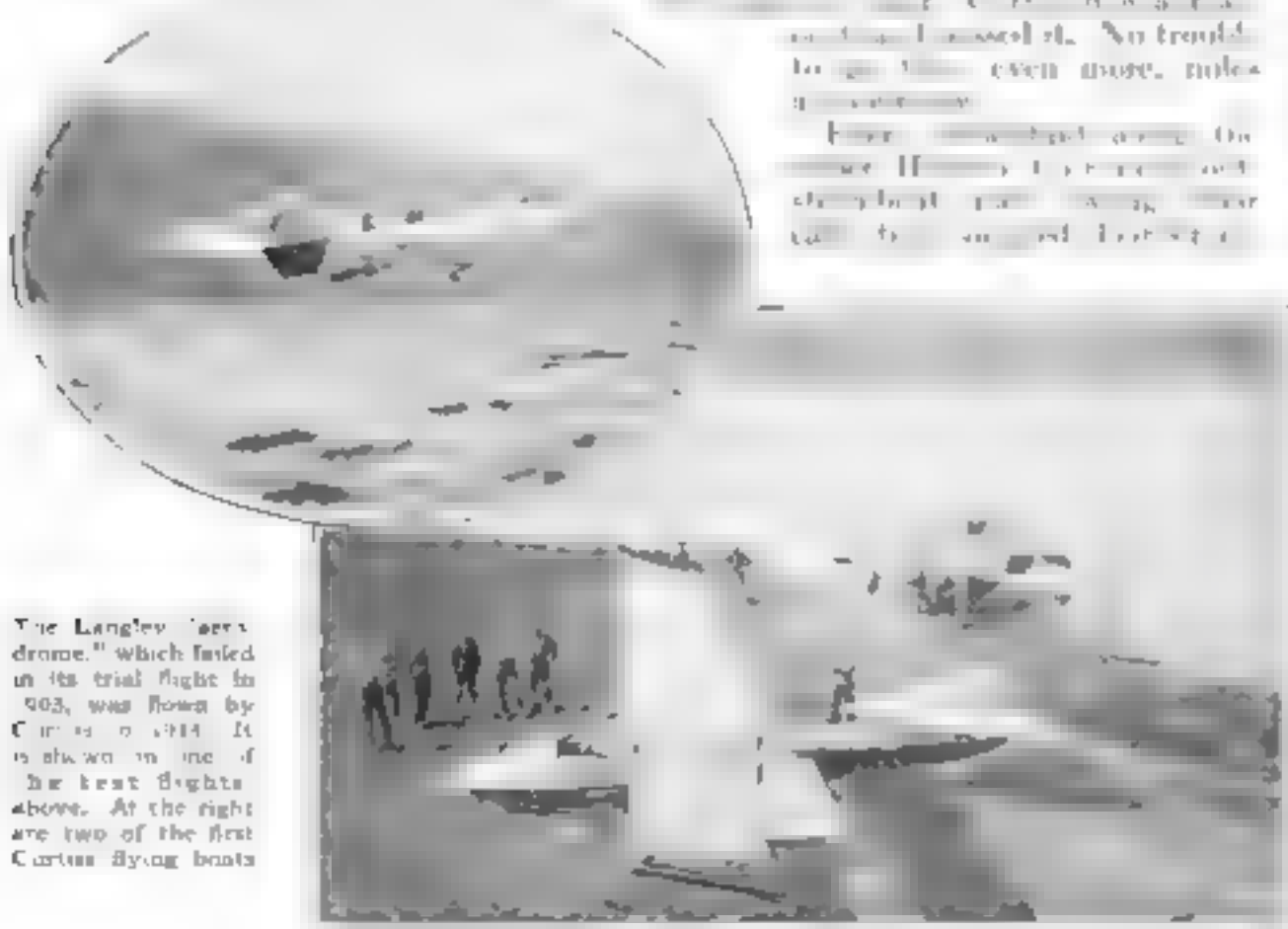
but the flyer heard nothing but his motor exhaust. He flew over the Poughkeepsie bridge, 150 feet above the rails, then circled eastward to a landing field at Camlot while the population stood on hillsides and roof tops and cheered. Down to a safe landing and nobody there with gas and oil as he had arranged! The man entrusted with the job of providing fuel and lubricant did not believe Curtiss was ever coming!

SEVERAL motorists volunteered help. And in a few minutes, with tank and crank case replenished, Curtiss rose for the second leg of the great flight. Even at that point he had already won the *Scientific American* trophy for the third time, with the longest continuous flight ever made—eighty-seven miles, from Albany to Poughkeepsie.

Approaching the Hudson highlands, Curtiss had his first experience with "holes in the air" that carry the plane downward irresistibly, occasionally taking a flyer's life as told.

The air boiled like a gigantic tea-kettle, cross currents, upward currents, downward currents, that let the airman fall until once he almost touched the water with a wing tip. Sudden drops of a hundred feet that seemed like a thousand. No man ever had tried to fly through air like this.

But in a few seconds the placid expanse of the Tappan Zee lay below him, the hazard passed. Crowds on the river (Continued on page 141.)



The Langley "aerodrome," which failed in its trial flight in 1903, was flown by Curtiss in 1911. It is shown in one of his best flights above. At the right are two of the first Curtiss flying boats.

Facts Everyone Should Know

These Fifty-Eight Questions Offer a New Way to Test Your Stock of Useful Information

HOW large is your stock of useful information? Have you learned the secret of selecting valuable facts and figures from the general run of information, and of sorting them in mental pigeonholes for future reference? Or have you allowed knowledge once gained in school or elsewhere, to escape you through neglect or disuse?

The four fascinating tests given below will tell you. They were devised recently at Columbia University as a test of general knowledge of science.

At first glance, the tests may appear difficult, but you will see that they have been simplified by the fact that in each case a list of the answers is given at the outset. All you need to do is to fit the

various answers into the correct spaces.

There are fifty-eight questions in all, including the dates of discoveries and inventions. If you answer thirty-five of them correctly you may be reasonably sure you are "well informed." If you score more than thirty-five you can put yourself down as exceptional. The correct answers appear on page 139.

Terms Used in Applied Science

THIS test will measure your familiarity with terms of applied science. See how many of the following ten terms you can place correctly in the spaces before the numbered statements.

pasteurization	filament	Benzene converter
turbine	gyro-stabilizer	cyanometer
ammeter	carburetor	
armature	radioactivity	

- _____ 1. The rotating part of a motor or dynamo.
- _____ 2. The fine wire in an electric light bulb which gives off light.
- _____ 3. An instrument for mixing gasoline and air to form an explosive mixture.
- _____ 4. An instrument for measuring electric current.
- _____ 5. A vessel for holding molten iron and changing it into steel.
- _____ 6. A rotating machine which derives its power from water or steam.
- _____ 7. An instrument for measuring the color of the sky.
- _____ 8. A huge spinning top used to prevent rolling of ships at sea.
- _____ 9. The property which some substances possess of giving off invisible but penetrating rays.
- _____ 10. The process of heating milk to destroy bacteria and prevent souring.

Great Inventors and Inventions

HERE are the names of twelve inventors and discoverers, and the dates of their important achievements. In the space before each of the twelve numbered statements write the correct name, and at the end write the correct date.

Isaac Newton	George Westinghouse	Olaus Roemer
Elias Howe	Samuel F. B. Morse	Galileo Galilei
James Watt	Alexander G. Bell	Richard Gatling
Thomas Edison	Cyrus McCormick	Johann Kepler

1837	1809	1834	1789	1893	1861
1687	1876	1675	1845	1609	1868

- | Inventor | | Date |
|-----------|--|-------|
| _____ 1. | Invented the first successful steam | _____ |
| _____ 2. | Invented the telegraph | _____ |
| _____ 3. | Invented the moving picture machine | _____ |
| _____ 4. | Formulated the law of universal gravitation | _____ |
| _____ 5. | Invented the air brake | _____ |
| _____ 6. | First measured the speed of light | _____ |
| _____ 7. | Discovered the laws of motion of the planets | _____ |
| _____ 8. | Invented the sewing machine | _____ |
| _____ 9. | Invented the reaper | _____ |
| _____ 10. | Invented the telephone | _____ |
| _____ 11. | Invented the machine gun | _____ |
| _____ 12. | First person to make and use the telescope | _____ |

Your Mental Measuring Stick

HOW accurately does your mind serve you as a measuring stick? Try to place each of the following twelve numbers in its right space before one of the statements below.

.000039	57½	660	6.080
.4	231	2,204.8	43,560
6	640	5,280	6,000,000,000,000

- _____ 1. Number of feet in one mile.
- _____ 2. Number of pounds in one metric ton.
- _____ 3. Number of acres in one square mile.
- _____ 4. Number of square feet in one acre.
- _____ 5. Number of degrees in one radian.
- _____ 6. Number of inches in one centimeter.
- _____ 7. Number of feet in one knot (one nautical mile).
- _____ 8. Number of inches in one micron.
- _____ 9. Number of miles in one light-year.
- _____ 10. Number of cubic inches in one gallon.
- _____ 11. Number of feet in one fathom.
- _____ 12. Number of feet in one furlong.

Remember These Measurements?

IF YOU are familiar with the different units of measurement, how widely can you apply them? See how many of the following twelve numbers you can place correctly in the spaces.

29.5	62.5	1,100	239,000
39	256	25,000	93,000,000
29,141	459.4	186,000	
		6,000,000,000,000,000,000,000,000	

- _____ 1. Number of miles around the earth.
- _____ 2. Number of feet per second sound travels in air.
- _____ 3. Number of vibrations per second of middle C on the piano.
- _____ 4. Number of miles from the earth to the moon.
- _____ 5. Number of degrees below zero Fahrenheit of absolute zero.
- _____ 6. Height of barometer in inches under normal conditions.
- _____ 7. Number of miles per second light travels.
- _____ 8. Mass or weight of the earth in tons.
- _____ 9. Distance in miles from earth to sun.
- _____ 10. Length in inches of a pendulum that beats seconds.
- _____ 11. Weight in pounds of one cubic foot of water.
- _____ 12. Height of world's highest mountain in feet.

Is There a Human *Speed* Limit?

Noted British scientist's remarkable experiments with athletes have revealed many amazing new facts about the mechanics and chemistry of running

By ARTHUR GRAHAME

WHEN Charles W. Paddock, the California sprinter famous as "the fastest human," not so long ago ran 100 yards in 9.5-10 seconds, he established a new American record, clipping one tenth of a second off the mark set by Arthur Duffy a quarter of a century ago. To do that, Paddock had to run at an average speed, pistol to tape, of $10\frac{1}{4}$ yards a second. In his stride, he must have been stepping about twelve yards a second, which means that he was traveling at the lively rate of twenty-four and one half miles an hour.

Is that the speed limit, or close to the speed limit, of the human runner? Do the remarkable records of sprinters such as Paddock and Bland Locke, and of middle-distance runners such as Nunn and Felsch Wade, represent the utmost in speed and endurance of which the human machine is capable? Has stern and inflexible Nature established speed laws which even the greatest of athletes may not break?

Science is answering these questions. Prof. A. V. Hill, noted English physiologist and winner of the Nobel Prize in medicine in 1922, has perfected a method of enabling him to measure the characteristics of an athlete in respect to expenditure of energy and to calculate his speed for a given distance. His predictions are based on studies of the effects on the human mechanism of violent effort and of fatigue, which, in conjunction with an ingenious timing method, may result in proving that in some of the shorter running events the best athletes have come so close to the human speed limit that future record breaking is likely to be in hundredths, rather than fifths or tenths, of a second.

THIS timing method, offering a degree of accuracy impossible with a human timer and the best split-second watch, consists of wire coils placed alongside the track at the starting line, at the finish and at intermediate points. The runner carries, attached to his waist by a tape, a small piece of magnetized hacksaw blade, and when he passes a coil a current is induced in it, and a galvanometer attached to the coil is deflected. These deflections are recorded on moving photographic paper, marked in units of time, in a special type of camera. The



Professor A. V. Hill, noted English physiologist, winner of the Nobel Prize in medicine in 1922, and recently nonresident lecturer at Cornell University. In his remarkable studies of the human muscular machine, he has perfected a method of timing runners which, in conjunction with other discoveries, has changed the human speed limit from a topic of cinder track argument to a subject for serious scientific discussion.

start is recorded by pressing an electric key at the moment the starter's pistol is fired. The timing slips provide a detailed and easily understood record



A man, running 100 yards in the record time of ten seconds, Professor Hill's experiments show, does as much work as would be required to lift him 300 feet in the air. He uses up 9 horsepower of energy. He generates $1\frac{1}{2}$ ounces of lactic acid (muscle fatigue). And he "runs into debt" for five to seven quarts of oxygen. An athlete's oxygen borrowing capacity is a reliable index, according to Professor Hill, of his ability as a runner, more especially in distance events

of the athlete's performance, even showing when the runner "beats the gun" by about a tenth of a second.

When I visited Professor Hill at Cornell University, where this spring he has been a nonresident lecturer in chemistry, he was conducting experiments on a small outdoor training track. Timing coils were placed at the starting line, and one, three, six, ten, fifteen, twenty, thirty, forty, fifty and sixty yards from it. The experiments showed that with all the sprinters examined it took, at the start, about one tenth of a second for the runner to flash the order "go" from his mind to his muscles. A runner who did the sixty yards in 7 and 50-100 seconds reached maximum speed at some moment between twenty and thirty yards, which seems to be the case with all sprinters. His last ten yards as a whole were the fastest. He covered them in 90-100 seconds.

A runner, Professor Hill explained, is subject to a retarding resistance proportional to his velocity. The faster he runs, the greater the resistance he must overcome. In effect it is the same as when a raindrop falls through the air; the resistance of the air grows greater as the speed of the raindrop increases.

"The sprinter who ran sixty yards in 7 and 50-100 seconds exerted a constant force of about eighty percent of his body weight. He started with an initial acceleration equal to four fifths of gravity. In running 100 yards he would do work equal to that required to lift his body 210 feet in the air. Another runner exerted a force equal to ninety-two percent of his body weight. In running 100 yards he would do work equal to that required to lift himself 276 feet in the air.

"A SPRINTER capable of running 100 yards in record time would perform work equal to that required to lift himself 300 feet or more in the air. In running 100 yards in ten seconds a man uses nine horsepower of energy.

This tremendous expenditure of energy supplies scientific basis for the belief, expressed by many prominent track coaches, that, when the present sprint records are beaten, it will be by fractions of a second so small that they can be recorded only by electric timing apparatus.

"Muscles contract and relax rapidly

when a runner is traveling at high speed," Professor Hill then continued. "Lactic acid—a product of muscular fatigue, a variety of the acid that accompanies the fermentation of milk—is manufactured at the rate of three or four grams a second, and our end one half ounces of this comparatively strong acid in the muscles at the end of a fast 100 yards will result in a considerable falling off in speed. Four ounces is enough to stop the athlete completely.

"A runner traveling at high speed—say, ten yards a second—must pay a tremendous price in energy for even a slight increase in speed. At high speeds

NEXT MONTH!

Every man thrills to the clang of the fire engine, but fire fighting today is a science that every one of us should know more about. Modern technical knowledge and the hard-gathered wisdom of experience are pitted together in our next story.

"CHIEF OF BATTALION"

By KARL W. DETZER

to appear in our July issue. It is a thrilling story of life in a fire department today, that you won't want to miss.

a muscle must burn up carbohydrates, and to do that it must have oxygen. But it is not necessary that this oxygen should come directly from the outer air. The muscles store up energy as a storage battery stores up electricity, and can use stored energy as an electric motor uses stored electricity. They are able to "borrow" oxygen and replace it after the effort has been made and the athlete is resting.

"In the sprints the athlete runs almost entirely on stored energy

and breathing is of slight importance. The distance is so short that he is unable to use up all his stored energy and so exhaust himself. In the longer runs the athlete's ability to borrow oxygen and repay it later is index to his ability as a runner.

It has been determined by experiments that the maximum oxygen intake of a runner is about three and one half quarts a minute, and that the maximum energy storage capacity is equivalent to about thirteen quarts. This gives him a total oxygen capacity of about sixteen and one half quarts. An athlete running at top speed can use up all his available energy in a little more than 300 yards. When he has done so total exhaustion is at hand."

I asked Professor Hill how he, as a physiologist, had become so deeply interested in athletics.

"MANY people ask me that," he replied. "Well, the physiologist's job is to study the chemical and physical activities of living organisms—muscles, heart, and so on. He studies, for example, the curious power a muscle possesses of adapting its liberation of energy to the work it has to do. In the marvelous performances of trained athletes he can obtain data of extraordinary exactness. Recently an athlete ran sixty yards for me, four times in succession. I had asked him to try to run at the same speed each time. His times were taken at ten points along the track, and the average difference in his times was only 14/1000 second! If I wanted similar data on industrial fatigue, where could I find a bricklayer of sufficient powers of coordination to lay bricks with anything like that regularity of performance?"

"The precise data that may be obtained from the performances of athletes enables the physiologist to place his subject on a level with the exact sciences. And to obtain this reliable data, extreme accuracy in timing instruments, of course, is absolutely essential.



The electric timing apparatus designed by Professor Hill, which he has been using Cornell University runners. Wire coils are placed at intervals along the track. The runner wears a magnetic belt, and his passing through the coils is recorded on a moving picture camera. The method used at the top meeting in a runner's time down to a five hundredths of a second.

most of the mechanical energy developed by the muscles is absorbed by friction. Only a small part is available to move the body forward. So the runner's energy is spent for poor coordination, results in a truly large production of lactic acid and consumption of oxygen, with consequent loss of speed.

"It is improbable that athletes of the future will be able to improve greatly on the starting speed of the present record holders. The strain on muscles and tendons already is tremendous. In the viscous elastic properties of our muscles Nature has provided a safety valve for the athlete determined to break records. The inevitable falling off in muscular tension that is the result of violent physical effort keeps him from wrecking the mechanism of the body in his efforts to smash

records. Once a sprinter has attained his maximum speed, the remaining distance to be run is so short that it is difficult for him to increase his speed greatly.

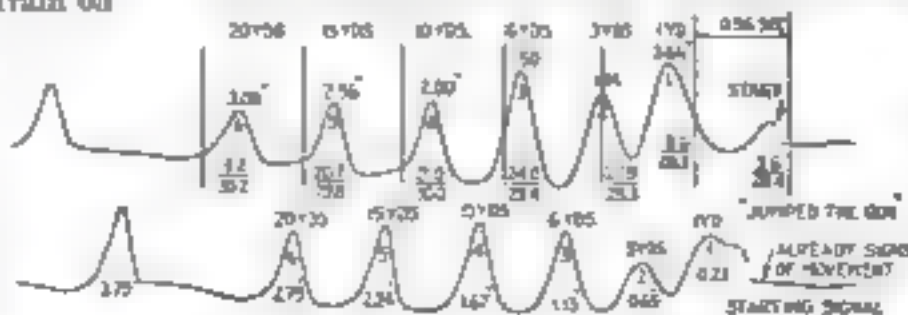
For these reasons I do not think that there will be any startling lowering of records in the sprint categories.

In the longer runs a runner's ability to borrow oxygen may be determined by his oxygen-carrying capacity.

Together a work



The start is recorded electrically, the resulting graph, as shown below, showing more accurately than a human timer and a split-second watch whether the runner "beats the gun." The photo shows Jack Moskley (left), Cornell track coach, starting assistant track coach Bangs, who is carrying a magnetized steel strip tied around his waist. Moskley holds an electric switch in his hand, which signals the start.

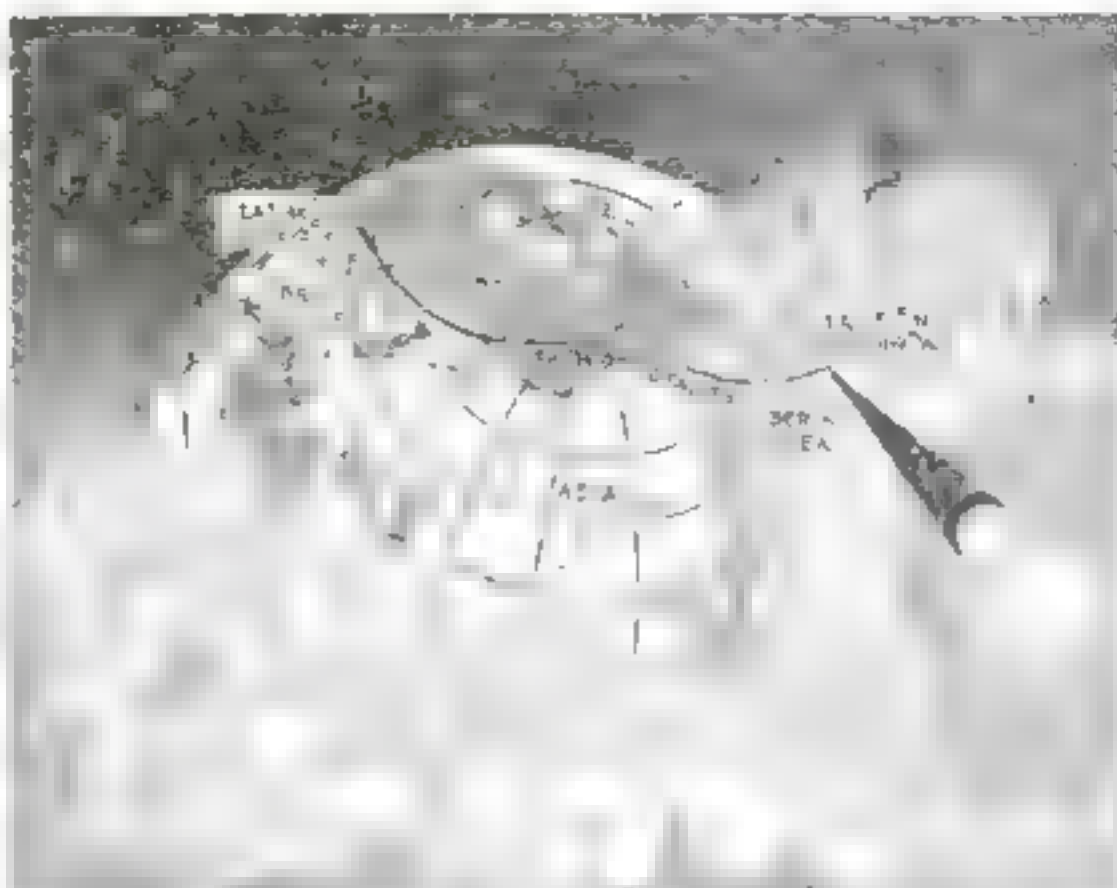


Irregularities in a runner's start are readily detected by a study of the graphs produced by Professor Hill's timing apparatus. These records showed a correct start (upper curve) and a "jumping the gun" start.

Sun's Next Eclipse on June 29

ASTRONOMERS from all over the world are gathering in Norway to view the total eclipse of the sun that will occur early in the morning of June 29. The United States, where memories are still vivid of the eclipse of January 24, 1925, is to send at least one party to study the eclipse the McCormick-Chaloner expedition from the University of Virginia.

The June 29 eclipse can be viewed in Wales, England, Scandinavia and Siberia. It will be the first total eclipse visible in England in 250 years. Special trains will carry Britons to the best points of vantage in the country, where, a few minutes after sunrise, they will see the



Path of the total solar eclipse to occur June 29 when the moon will pass between sun and earth. Traveling at fifty miles a minute the moon's shadow will start the eclipse on the Atlantic Ocean at sunrise sweep across Britain, up Norway, into the Arctic Ocean and through Siberia. It leaves the earth at sunset, having taken two hours to slit across the earth.

sun blotted out for nearly half a minute.

Three other eclipses are scheduled for 1927. The first, a total eclipse of the moon, will be visible throughout this country early in the morning of June 16. Another total eclipse of the moon and a partial eclipse of the sun are due in December.

Scientists find the reward for eclipse expeditions in studies and photographs of the sun's outer atmosphere that could be made at no other time. The American expedition, for example, hopes to reveal new secrets of the mysterious chemical element "coronium," thus far detected only during total eclipses in the hot gases surrounding the sun.

Great Hudson Tunnel Undergoes Health Tests



Watching a ventilation test of the under-Hudson tunnel, made with smoke bombs

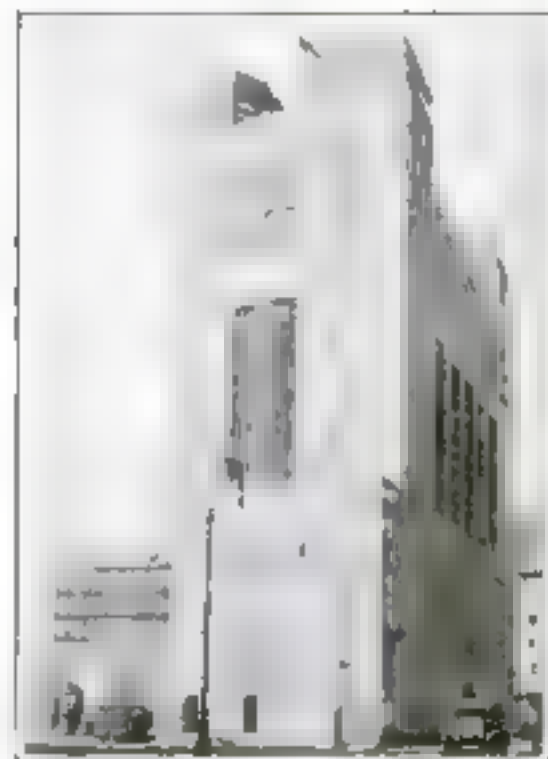
THE ventilating system installed in the new Hudson River vehicular tunnel connecting New York and New Jersey has been, perhaps, the most important of the stupendous problems involved in this great engineering feat. If the ventilation is not adequate in a tunnel designed to carry motor vehicles, there is a possibility of serious injury to the health of drivers using the tunnel.

To solve it, the engineers abandoned the usual scheme of forcing air in at one end and sucking it out at the other. Instead, they made ingenious use of the space at the top and bottom of the circular tubes, as shown in the drawing at the upper right. At frequent intervals along the tunnel, fresh air is forced in

from a duct beneath the roadway. Impure air and the deadly carbon monoxide gas produced by the running motors are supposed to flow into the upper duct and out of the tunnel by way of enormous stacks in the ventilating buildings, one of which is shown at the right.

Smoke bombs and smoke candles are being used to test the flow of air in the tunnel. By this means it is possible to get visual proof of just how rapidly the ventilating system will remove the exhaust gases of motor vehicles.

At this writing several tests have been made. Engineers are now checking the results, and expect them to show the tube safe before it is opened to the public—probably in August of this year.



Ventilating building on New York side housing fans that purify the tunnel air. Above, the new tunnel, 20½ feet in diameter, compared with Hudson railway tube

The World's Progress in Science

On these pages are presented each month brief stories of scientific discovery and research having practical bearing on our everyday problems.

No "Criminal Type," Survey Shows

THERE is no such thing as a "criminal type," we are now told. The average criminal is a normally intelligent individual, and consequently our methods of punishment, which are based on the theory that he is a "type" and not an individual, are doomed to failure.

Such are some of the findings of the most comprehensive study of a large group of criminals ever undertaken, when the personal and family history, environment and characteristics of 3,003 offenders in the New York Court of General Sessions were studied recently by psychologists and physicians under the supervision of Edwin J. Cooley, professor of criminology at Fordham University. Professor Cooley, who is also Chief Probation Officer of the Magistrates Courts of New York, offers the following conclusions drawn from his investigation:

There is no single cause or combination of causes for crime; there is no such thing as a "criminal type." The majority of criminals are of normal intelligence, not feeble-minded. Environment alone is not a cause of crime.

The real cause of crime, the investigation seems to show, is to be found in neglected and unmannered youth. Of the 3,003 criminals studied, 44 percent were under 21, 62.8 percent under 25.

Extension of the probation system and segregation of nonreformable criminals are recommended in the report.

Relics of Ice Age Americans—?

ARCHAEOLOGISTS, digging into the soil of America, have recently come upon fascinating evidence that men lived on this continent far earlier than has been generally believed—perhaps a million years ago! This evidence, gathered by J. D. Figgins and Harold J. Cook of the Colorado Museum of Natural History at Denver, consists of arrowheads and other implements found buried with the fossil bones of extinct animals in ancient geological deposits in Oklahoma, Texas and New Mexico.

The Indian is thought to have first come to America from Asia between 8,000 and 25,000 years ago. The newly found relics, however, are believed to date back to the great Ice Age when northeastern America was covered periodically with an immense glacier and when prehistoric elephants and mastodons roamed the land.



"Merry bullets" that stun instead of kill will be used by Capt. Barnett W. Harris, of Chicago, to capture wild animals. An anaesthetic within the bullets, which can be fired from shotgun or rifle renders the animal temporarily unconscious. Two types are shown in the photo at the left.

This was 25,000 to a million years ago. Mummies unearthed from the burial caves of ancient 'Basket Makers' in Arizona have revealed that the American woman who lived about 1500 B.C. bobbed her hair. Her husband let his hair grow long and braided it. Buried with one prehistoric woman was the mummy of a small lap-dog!

New Anaesthetic Tested

DISCOVERY of a new anaesthetic, said to have important advantages over ether or chloroform, is claimed by German surgeons. Known as "107," it has proved successful in 300 tests, according to Dr. Ernst Lorch of Berlin.

Under its influence, pulse and blood pressure of patients are said to remain normal, disagreeable after-effects and danger to heart, lungs or nerves eliminated, and operations possible even in severe cases of pneumonia and advanced tuberculosis. Since it requires no inhalation mask, it permits operations on the face, nose and throat. A bromine solution, "107" is introduced into the intestines.

Rubber Chemistry Magic

WE SHOULD find it hard to get along today without rubber; yet its countless uses would have been impossible without the ceaseless work of chemists. Dr. W. C. Geer, one of America's foremost rub-

ber experts, recently stated that the world owes a billion dollars a year to chemistry in the rubber industry alone.

This billion is represented in the production of better rubber by speedier processes. Our automobile tires, golf balls, garden hose and gloves last twice or three times as long as they used to. New chemical processes have almost entirely cured the tendency of rubber articles to become hard and dry with age. In fact, but for the chemists, says Dr. Geer, the world's supply of rubber would have been exceeded long ago by the demand.

High Wages Boost Inventions

INVENTION of labor-saving devices in industry is being more than ever stimulated by the increase in the supply of "cheap labor" in this country, says Prof. Robert D. Ward, of Harvard University.

From one end of the country to the other, reports of new labor-saving machinery are coming in almost daily. New coke-handling apparatus, mechanical brick makers, truck layers, and numberless other machines are replacing crude hand labor and at the same time saving money. The question, "Who will dig our ditches?" is answered by mechanical ditch diggers, the largest of which can do the work of four hundred men!

The rapid development of new machines to do rough work is not only decreasing unemployment, Professor Ward



Tests are still being made to solve the mystery of the destruction of the dirigible Shenandoah. Above is a machine devised at the Bureau of Standards to test girders made by the same process as the Shenandoah's, to discover whether structural weakness caused the mishap.

"Mercy" Bullets for Animals—Alcoholism in Rats—Dancing Measured in Calories New Anaesthetic, and Other Discoveries

finis, but is smoothing out the peaks and hollows of seasonal employment. He prophesies that the new industrial situation, while increasing labor costs, will nevertheless lower production costs.

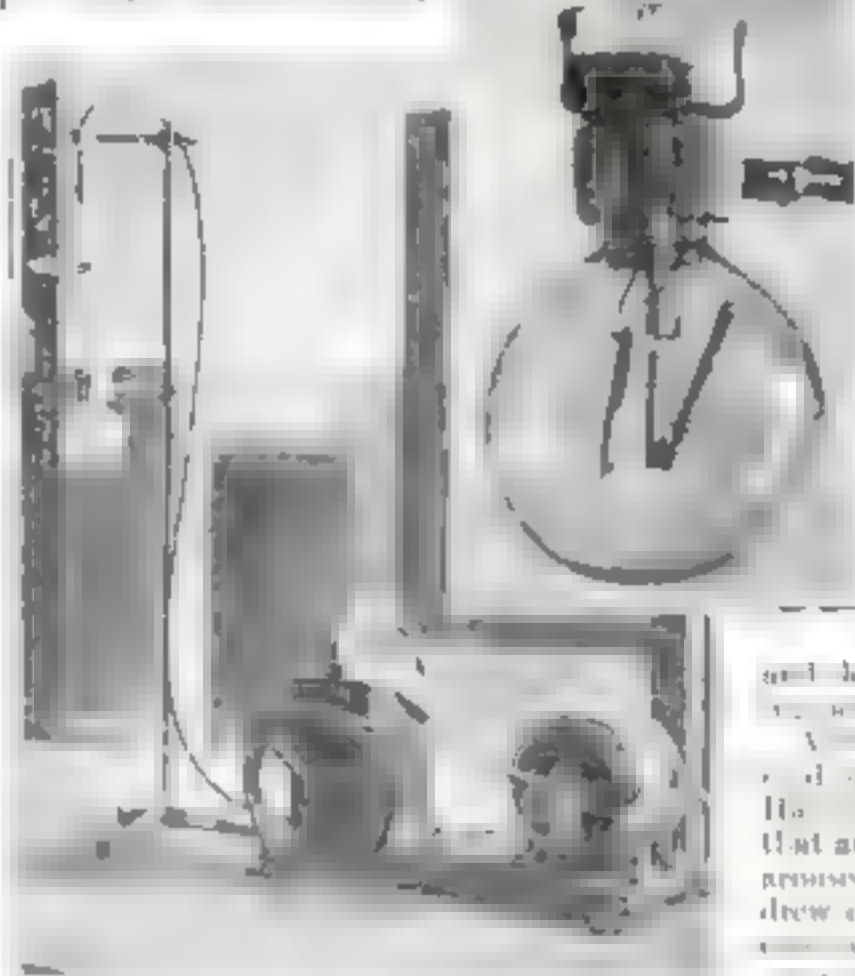
Twins Alike Even in Unlikeness

NO TWO things in the world are exactly alike, we are often told. A close approach to duplication, however, is found in the case of "identical" twins; that is, twins believed to have grown from the same fertilized egg cell, as distinguished from ordinary or "fraternal" twins. Recently a Japanese biologist, Dr. Taku Kemon, reported the results of studies which show that in some instances twins actually may be more like each other than are the two halves of a single individual. For example, the right hand of one identical twin resembled the right hand of his brother more closely than did the right and left hands of either twin!

How Dances Burn Us Up

SCIENTISTS at the University of Helsinki, Finland, have just completed interesting measurements of the energy consumed in dancing, in terms of heat units. The fast polka consumed the most fuel—10.87

"Radium clock" exhibited recently at Chicago University



Radium "tells" the time, in this amazing new instrument. Within a vacuum bulb, an electrically charged gold leaf "tells" the time, swinging alternately back and forth each half minute, under the influence of the alpha rays of the radium. A high vacuum is obtained with a motor-driven pump.

the index of the sea, Dr. A. F. Bernard Shaw, of Newcastle, England, recently made this discovery while studying the white corpuscles of the blood. These white cells, whose duty it is to fight disease germs which enter the blood, are known to vary in numbers from time to time. Dr. Shaw found that the number increases and decreases in two regular daily waves.

The high tide of white corpuscles usually comes just after midnight, and again in the afternoon. Dr. Shaw suggests that these tides may bear some relation to the hours of eating

and sleeping—or may be due to changing positions of sun and earth.

Another strange thing just discovered about our blood by Dr. W. M. Hoar, of Basel, German physician, is that anger makes it turn sweeter. He aroused anger in human subjects, then drew off samples of blood. In every case, he found more sugar in the blood than before.

Now he offers us his belief that anger is nature's way of preparing the body for combat. More sugar in the blood immediately supplies food for the muscles to act quickly.

Alcoholic Rats and Heredity

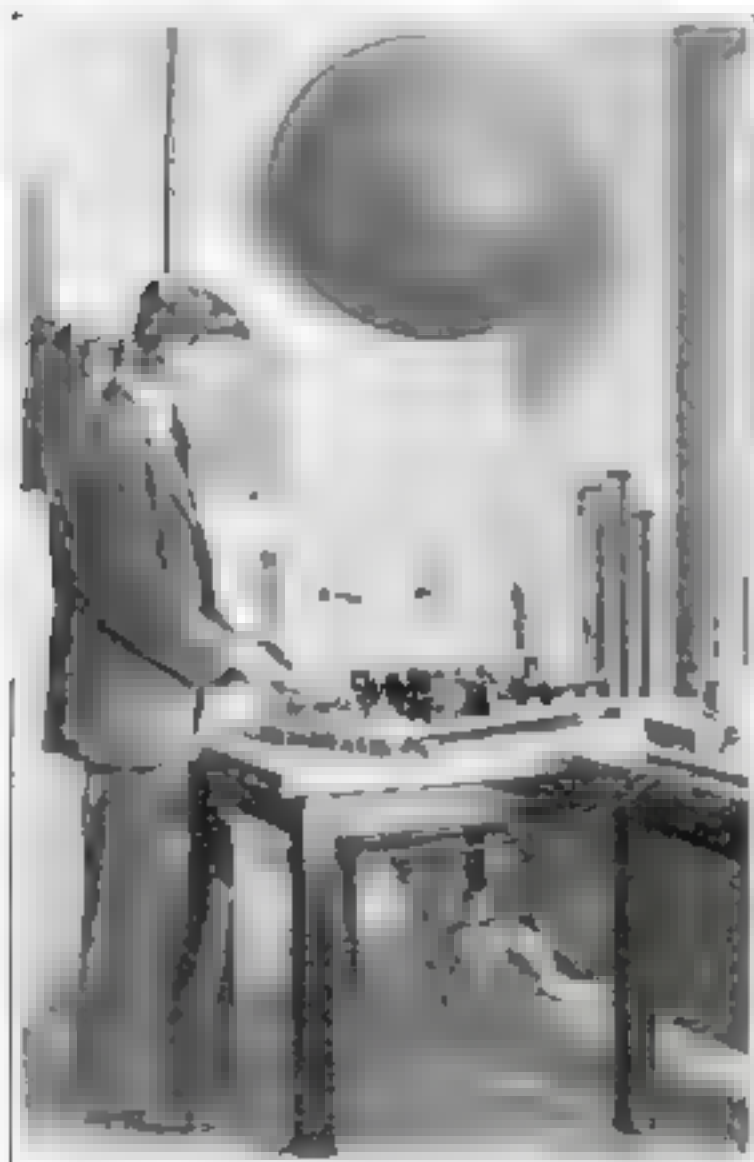
JUST because a person is descended from hard-drinking ancestors or a dog from a he can "hold his liquor" better than others, nor does it mean he is more likely to turn into a drunkard. Such are the conclusions of Prof. Frank B. Hanson and Miss Florence Hays of Washington University, St. Louis, Mo., after staging a series of drinking tests with rats.

In a tight box they placed ten rats, five of which were descended from ten generations of drunken ancestors and five from sober forbears. After saturating the air in the box with alcohol fumes, the experimenters observed the time it took the animals to keel over. Repeated tests showed virtually no difference in their resistance to the drug.

More Antennas, Weaker Signals

AN INTERESTING new fact about radio broadcasting has been revealed by R. H. Barfield of the English Radio Research Board. It is this: The strength of a signal received on your set depends materially on the number of other radio listeners tuned in. In other words, every additional antenna takes energy from the broadcast signal.

By testing waves received from the same station in various directions, Mr. Barfield found that the energy, after passing over districts with many antennas, was noticeably less than after passing sparsely settled regions with few antennas.



Science now "hears" the atom, too. By means of this remarkable device, invented in Germany, the movement of millions of atoms in a bar of soft iron, when disturbed by a magnet, can be heard distinctly as a peculiar roaring.

calories an hour for each kilogram of body weight, or almost twice the energy consumed by a sterner type, say, by trade. The polka required 7.06 calories, fox trot, 4.78; schottische, 4.56, while the waltz used up the least energy—3.90.

Science and Conservation

REGARDING future development of natural resources, Secretary of the Interior Hubert Work says: "Science can help us find new wealth in materials trodden under foot as worthless."

A dirty yellow mineral found on barren slopes of Colorado proved to be radium, boon to the suffering. Helium gas was found in natural gas from Kansas wells. Today it is being used for inflating airships, for cooling electric generators and motors and filling radio tubes, in the treatment of disease; even to make toy balloons safe for children!

Priceless wealth lies hidden all about us.

Blood Has Daily Tide

IN THE blood stream, pumped from the heart to give us life, there are daily tides, like the ebb and flow of



THEY took turns pumping the bellows of their enlarged blast furnace. A month after landing, almost naked on that desolate spot, they had manufactured out of the island's raw materials more than a ton of steel!

Bare Hands

Illustrated by J. Clinton Shepherd

Science and Ingenuity Put to the Supreme Test

By HAWTHORNE DANIEL

CRISISING among the Aleutian Islands, four Seattle yachtsmen—Parker and Thornton, partners in an engineering firm; Williams, a young naval architect, and Kelly, a deck hand—were captured and imprisoned in their own yawl by Kiska Joe, murderous half-breed seal poacher. A shipwreck separated them from their captor, but cast them with Oomak, one of Kiska Joe's crew of native Aleuts, on the desolate shores of Devil Island. By killing game they supported themselves with food and clothing, and by smelting ore found on this island they made tools of steel. A weird cry that echoed through the island mystified them, for they could find no trace of inhabitant. They planned to build a boat to be driven by a steam engine fashioned from iron ore. But just as they were beginning work on the boat, Kiska Joe's schooner appeared offshore. He had returned to search for them. When the poacher reached the beach in a small boat, Parker, overjoyed at the chance of rescue and acting against the advice of his comrades, hurried to greet his former captor. He was immediately seized and bound. Kiska Joe and one of his men, armed with rifles, then advanced against the other castaways who lay concealed behind rocks at the top of a cliff. As Kiska Joe drew near, Kelly rolled a boulder down upon him. Now read on.

A BRANCH snapped as the boulder fell, and with the quickness of a mountain goat Kiska Joe leaped. He was gone too soon for the rock crashed within five feet of him. Then bounded down the ravine until it splashed into the stream. Even before it came to rest in the water, Kiska Joe lifted his rifle and fired four shots in rapid succession in the direction from which the boulder had fallen. Kelly heard the bullets spatter on the rocks before him.

"Well, he knows we're here," whispered Thornton. "He may not come any farther."

But Kiska Joe was not to be frightened by a single stone. Again he started forward, keeping well to the other side of the

ravine. Thornton raised his head a trifle to see where their enemy was, and a bullet clipped the leaves close to his ear. Kiska Joe had dropped the packages he had been carrying, and now was ready to fire at any movement he could detect. His follower, too, stood ready with his rifle.

The group of castaways at the edge of the ravine were in desperate plight. They could not fight, except with stones, and the two attackers now were well beyond the reach of stones. Retreat was the only thing left, and they began silently to creep away. Hardly had they started when they were frozen in their tracks by a shrill, unearthly cry from far down the ravine. It came nearer. They stood asteming. They had heard that sound before.

OOMAK began to whimper. They heard Kiska Joe and his follower cry out, then the sound of hurried footsteps. And when the group above the ravine approached the edge once more the two poachers had disappeared. The cry, too, seemed now to be moving away. They could not tell what it was, but obviously it was the same sound they had heard that first day on the island. They looked once more down the ravine, but nothing was in sight. Obviously, Kiska Joe had fled. Reaching the cliff edge, they gazed out across the beach.

The schooner still lay at anchor a mile away, but the boat had left the beach. Kelly made it out as it was being hurriedly rowed toward the schooner. They saw it go alongside, and saw four tiny figures climb on deck. Plainly Parker was with them, a prisoner. But why had Kiska Joe fled from the cry? And what had made the sound? Oomak was the only one who tried to explain it. He wished now that he had risked Kiska Joe's anger, for at any rate Kiska Joe was a man, and this thing that shrieked about the island—well, these white men could say what they pleased, but *he* knew, and knowing, he was afraid.

It was a downcast group that assembled in the cave that



There was a cry. A body fell to the ground. A hand reached through the door and lay with its fingers outstretched in the firelight. The men about the table jumped to their feet.

evening. They blamed themselves for Parker's capture. What would happen to him, they could not guess. Furthermore, they suspected that Kiska Joe might take it into his head to land again sometime, to surprise and capture the rest of them.

They realized they would have to guard against a surprise attack, and so for the next week they labored at erecting across the narrowest part of the ravine, a barricade that would prevent anyone from coming up their path. They made a ladder for their own use, and kept a constant lookout lest Kiska Joe should come upon them unobserved. It was while they were working on the barricade that they discovered the packages Kiska Joe had dropped. One was a ham, which they pounced upon with delight. The other was a small bag of dried beans. Both, apparently, had been intended as offerings to the spirits of the island, but they were welcome additions to Oonak's larder.

Having completed the barricade, they made a circuit of the island, and found two other places where routes led up the cliff to the high table-land. One of these they were able to break down, for it was merely a pile of tumbled rocks that formed an irregular series of steps. But the other could not be destroyed, and they had to content themselves with cutting small trees and brush, and covering the place, hoping that thereby it would escape discovery.

Furthermore, in the evenings Thornton busied himself with making four wooden guns, which he blackened with charcoal.

"Not much good for offense," he explained when Williams laughed at him. "But once we get behind our barricade, they may make a showing that will keep Kiska Joe back."

"Couldn't we make gunpowder and real guns?" asked Kelly, whose admiration of Thornton had grown to the point where he thought the engineer might be able to construct anything.

"IF YOU'LL find some sulphur and saltpeter we'll do it," nodded Thornton. "But I'm afraid they aren't here. Anyway, we don't need firearms. We can line the edges of the ravine with boulders, and if anyone tries to come up we can roll them down, and they can't get past our barricade."

It was a week to the day after Parker's capture that they resumed their work on the boat. Within a few days the logs were all split and laid out where the sun would shine on them. In that time Thornton had planned their program.

For a week they made charcoal, until they had a huge pile beside their blast furnace. Next they made two litters on which to carry ore, and pressing Oonak into service, they made trip after trip, hauling about two hundred pounds of ore at a time. Their method of weighing it was simple. Thornton weighed one



The lathe driven from the water wheel by a belt of seal skin was made with wooden shafts, pulleys and bearings.

hoisted and forty pounds, and so they placed him on a litter. They lifted him, and then tried to approximate his weight with a load of ore.

"How much will we need?" asked Williams. "And how can you tell?"

"We can't tell exactly," replied Thornton. "But this ore is rich. Judging from the amount of metal we got from the ore we smelted before, it should be about seventy percent iron. In other words, nearly three hundred of each four hundred pounds of ore is iron. Of course the way we have to do it, we can't get that much out of it. But suppose we get fifty percent. Then, if we want two thousand pounds of iron and steel, we will need two tons of ore. To be safe, we better have more. We may run a lot of it. Let's take thirty litter loads. That ought to be enough. If it isn't we can go for more."

SO THEY carried thirty heavy loads of ore and piled it beside their furnace, and then devoted a day to breaking it up into small pieces. Nor was that all. They found a small bed of limestone.

"Fine," cried Thornton when Williams came in with a bit of the stone. "Fine. I didn't think it would be here. It's probably the deposit from some old dried-up hot spring."

"Huh," granted Kelly. "Do we have to carry a lot of that stuff, too?"

"You bet we do," replied Thornton. "But not so much of it as we carried ore. That's something to be thankful for."

After two weeks spent in making charcoal, and in carrying ore and limestone, they were ready once more to start smelting.

"We'd better repair the furnace," suggested Thornton. "We don't want to stop, once we have it started, until we've finished the job."

So, while Williams complained and Kelly grumbled, they cleaned out the crumbylike affair, enlarged it, made larger bellows operated by jointed sticks arranged something like pump handles, and at last fired the furnace with kindling, charcoal ore, and limestone.

"Now for pig iron," said Thornton. "We can't cast as we go, so we'll have to remelt the metal once we get it. He

thrust a burning brand through the cinder notch to ignite the kindling, and leaving Williams and Thornton to pump the improved bellows, he set about digging a series of complicated ditches in the sand, with little channels leading to small oblong pits two or three inches deep.

"What's all that for?" asked Kelly, pumping until the flames shot out of the stone furnace.

"To make pig iron," replied Thornton.

"Pretty small pigs, don't you think?" asked Williams.

"Done purposely," returned Thornton. "We can't handle big ones."

Within an hour the molten metal began to collect in the bottom of the furnace, and after another hour Thornton broke the clay stopper and let it run forth. He watched it carefully to determine just how rapidly it was collecting on the hearth, and enlarged the hole from which the molten metal ran until he regulated the flow almost to balance the speed at which it was collecting. Using crude wooden shovels they had chopped out with the adze, they kept the little furnace filled with the three essential elements. They took turns pumping the bellows, shoveling, and watching the flow.

Thornton directed the flowing iron into a set after set of the crude molds, building little dams of sand across his main channel, tearing them out and re-building them farther down. All day they worked and on into the night. The morning sun rose again before the last of the stream trickled from the coked snout and the worn group went to their cave and threw themselves upon their beds.

It was done. A month after landing almost naked on that desolate spot, they had manufactured out of the island's raw materials more than a ton of iron.

Early the next morning they were ready once more to renew their labors, yet almost at once they were confronted by a new and puzzling mystery.

Ooniak had set about getting breakfast, and first looked for the axe, to split some wood. It was gone. At first they did not take the loss seriously, and then Ooniak suddenly discovered that the piece of bark they had not eaten had disappeared as well. It was only when they began a systematic search that they found

the one sign that had been left behind. On a smooth rock a dozen feet from the door of the cave was a new carving done with charcoal. It had not been there the night before, for on that rock Kelly had sharpened the adze, and Williams had rubbed the axe blade. It was a weird and very crude drawing of a bird with a huge beak—with great round eyes, with powerful wings—drawn in full flight. It was not unlike some of the strange birds that surmount totem poles.

Ooniak's eyes grew wide when he saw it, and he blanched beneath his swarthiness.

"The devil come to kill us!" he cried. "It is the sign. It mean we die—we have enemies—devil—maybe. It is the sign!"

That someone was on the island beside themselves they felt certain now. Still, though they made another entire circuit of the island near the shore line, they were unable to find a sign of any other inhabitant. So they returned to their tasks, determined to guard themselves and their possessions even more carefully than before.

They decided upon a division of labor. Williams and Kelly built a little dam across the stream and erected a water wheel, while Thornton constructed a lathe. Ooniak, in the meantime, surprised two more seals on the beach, and killed them. The skin of the first one, removed whole, was nearly half full of seal oil. The Aleut wanted one of them for an offering to the devils of the island, but the others refused. Instead, the two skins were tanned after Ooniak had scraped them clean with his obsidian knives.

THE lathe, driven from the heavy water wheel by a belt of seal skin, was a roughly built contrivance, made with wooden bearings, wooden shafts, wooden pulleys, and a wooden frame. There was little metal in it except nails, rivets, chuck, and spindle. But it worked, and on it Thornton made an improved set of wooden shafts and bearings to replace the ones built by hand. Then he forged a shaft of metal on an anvil they had cast, and after pacing the forging in the sand as he would have placed a piece of wood to be turned, he managed, after two days, to get it turned down with the tools he had made and by using sand and stone as abrasives.

(Continued on page 43.)

A Wonderland of Science

Amazing machines seen at Popular Science Institute of Standards that guard you in buying tools and radio equipment

By

ALDEN P. ARMAGNAC

TWO thousand men pulling on a hammer handle! Corrugated with massive gears, a huge wheel turns slowly, almost imperceptibly, but with inexorable force! A mechanical hand two thousand times stronger than mine pulling on the handle of a hammer the claws of which clutch the head of a heavy wire nail. The nail itself is clutched to the head of the machine. Yet the mechanical hand pulls the nail with childlike ease! That night met my eyes as I entered the laboratories of the Popular Science Institute of Standards. Two engineers were bending over the machine that trapped my attention. They were measuring a strange thing—the grip of a hammer's claws!

You or I might buy a hammer like that. Would we grasp a nail with it, only to see the nail slip through the claw? Wait a moment—over the round dial, a needle flickers. The nail writhes free from the machine's base, and the gears stop. The hammer's claws, holding the nail with a viselike grip, passed the test!

Next, will our hammer head stay where it belongs? Is its face tough and durable? Will the handle break? Like a carpenter's arm, but made of steel, another machine pounds the hammer on an anvil ten thousand times, trying to dent its face or loosen its head. Then a plunger squeezes a tiny hardened steel ball into the head with terrific force to test its hardness. Last, the handle is deliberately broken.

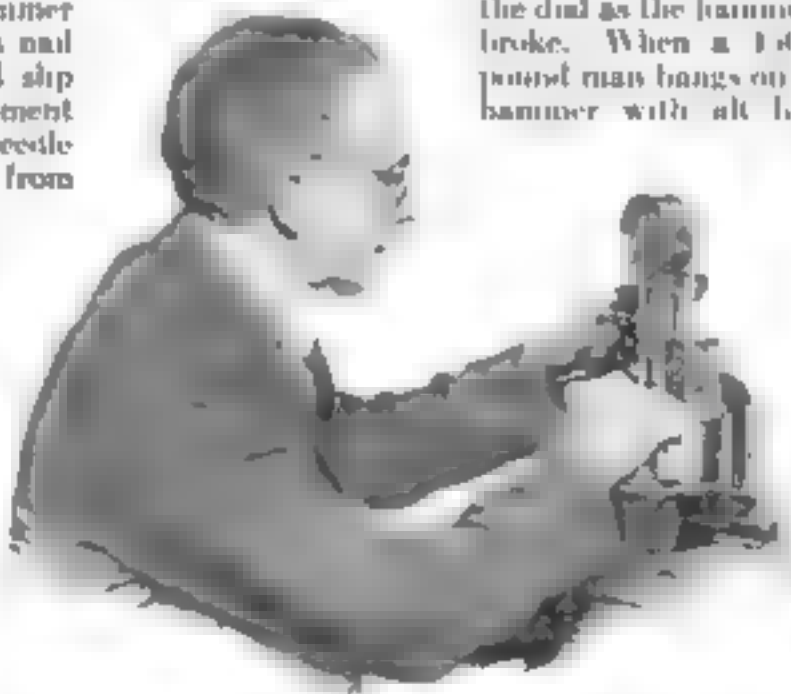
Did you ever break a hammer handle, tugging on a balky nail? Back goes the hammer to the first machine. This mechanical hand pulls on the hammer handle while the tip of the claw clutches a husky bolt—that can't let go! Some-



Talking over the results of a loud speaker test. Prof. Collins P. Blinn, director of Popular Science Institute of Standards (left), and Alexander Benavise, radio engineer.

thing will have to break. The gears revolve. The needle swings downward. The handle creaks under the mounting strain. Snap—the hammer lies useless, its handle broken in two. How much strain did it take?

More than two hundred pounds on the ten-inch hammer handle registered on the dial as the hammer broke. When a 140-pound man hangs on a hammer with all his



How hard are the plier jaws? C. T. Schwab of the Institute staff is conducting this test. All tools are tested by machines simulating human handling, and every tool passed is guaranteed.

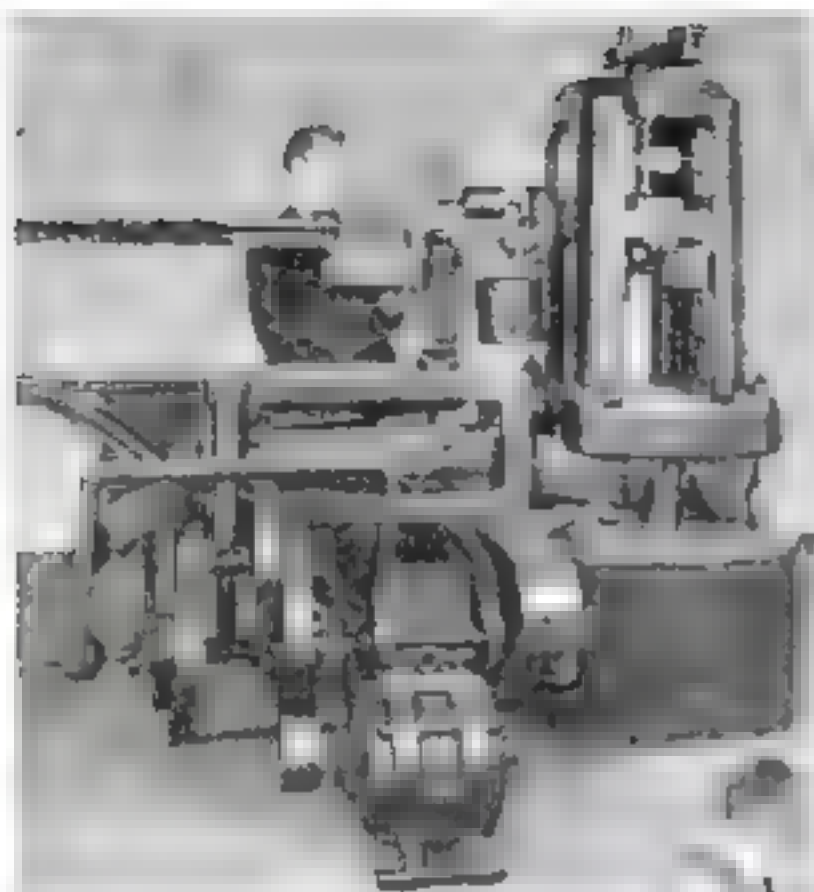
weight, he gives it all the punishment a good tool should be able to stand. This hammer did better. If you bought one like it, you need have no fear that it might fail you, for these tests, completed in a few minutes, have given it as severe treatment as it would get in years of everyday use.

At no other laboratory in the world are there such tests. They have been invented to simulate as closely as possible the way you or I might handle a hammer. The machines are as nearly human in their movements as scientific ingenuity can make them.

In these amazing laboratories are machines to test almost every kind of tool and every type of radio apparatus. And each of these tests is just as thorough as that for a hammer. These tests were established to protect you and me in our purchases of apparatus of a technical or semitechnical nature; to tell us whether the radio set, the loudspeaker, or the tool we buy is a good one; to substitute, for guesses, scientific tests of hairbreadth accuracy.

In the radio laboratory, for example, novel tests supplement examination of a radio set's parts. Before a set has emitted a single sound, institute experts can tell you just how well the outfit will reproduce a speech, a string quartet or a brass band.

Absolute silence filled the room. The immense loudspeaker on the wall was mute. Alexander Benavise, radio engineer, was testing a receiving set. Only quivering indicators on the electric dials of his instrument betrayed the source of the figures he was jotting down. Yet with these figures he traced a curve on a sheet showing at a glance the tone quality of that particular set. He knew definitely and accurately whether it would give you a throaty gurgle and an unintelligible distortion of the human voice, or a faithful reproduction of the music and voices that its antenna brought to it.



A giant testing machine at the Institute crushes the jaws of a bolt clipper as easily as if they were cardboard; a scale measures the force.

Signals to test radio receivers come from a miniature broadcaster right in the laboratory. Outside signals might vary in strength and spoil the tests. But here is a transmitting station under instant control, that produces a radio wave to correspond to any desired component of an orchestra or human voice. Popular Science Institute tests for radio equipment, Mr. Senacke told me, are the most complete in the world.

Every day the engines of these laboratories answer scientifically the layman's questions: "How well does it work? How long before it wears out?" Every day brings new problems, problems for which they must invent new tests.

There was the manufacturer, for instance, who was trying a new steel for the shank of his spiral ratchet screw driver. He came to the Institute's tool laboratory and asked how long the groove in his new tool would last. The wear on the groove, twisting the screw driver in response to a straight push on the handle, depends on the pressure of thrust. To test the hardness of the steel used in the tool was easy. But the manufacturer expected the Institute to tell him just how long the tool would last. So a new test, a test for spiral ratchet screw drivers, was invented.

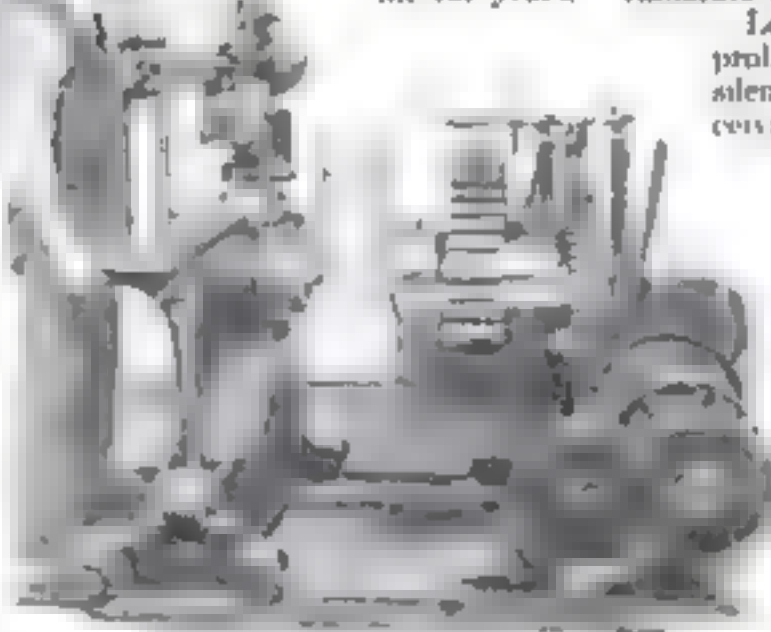
THE Institute engineers, therefore, drove into an oak plank an ordinary wood screw—twisted as tight as a man with a hand screw driver could set it. Then they mounted the block, screw and all, on a rotating spindle. They put on a brake drum, too, with an adjustable brake, and set their brake at a tension that was just a shade more than that required to turn the screw. Then they mounted the spiral ratchet screw driver in a reciprocating machine that thrust it back and forth against the screw on the braked wood block. The screw sank into the wood until its tension equaled that of the brake—then the screw balked and the block spun. From then on, the tension on the screw driver blade was a lifelike imitation of a

screw being driven home.

The device was run continuously for several days. At the end of that time, the screw driver had delivered enough strokes to drive forty thousand wood screws! It had had the equivalent of years of heavy everyday usage. And the manufacturer was given the information which he sought.

A versatile device, this reciprocating machine—it tests pruning shears as well. Their weak point is the flat coil spring that opens the blades. A few thousand times open and shut tells the story. If the spring is still undamaged, a similar pair of shears will last you or me for years.

shears will last you or me for years.



While massive gears revolve, a mechanical hand pulls the turner, clutching the nail, and so the grip of the jaws is determined.

Screw drivers and monkey wrenches torn to pieces! A strange machine twists a screw driver to find when its handle will splinter, its point chip, or its shank twist

apart. Another clamps a wrench on a square steel bar and then forcibly twists it off, to see what will happen to the jaws.

Thumping machines, pounding machines—that lift a heavy weight a standard distance to let it drop like a pile driver on the tool in their jaws—stand beside giant testing devices. A monster nutcracker smashes bolt clippers and pliers to bits. Other devices run by electric motors twist and pull apart husky bars of the same cold rolled steel that goes into tools. The largest of them has a crushing strength of two hundred thousand pounds!

WHILE these mammoth testing machines are devouring tools in their jaws, more delicate tests go on in the radio laboratory. When B-battery eliminators first appeared on the market, it was at the last tide of standards that their hum was actually measured and compared. Vacuum tubes and batteries receive the Institute's seal of approval only after elaborate tests.

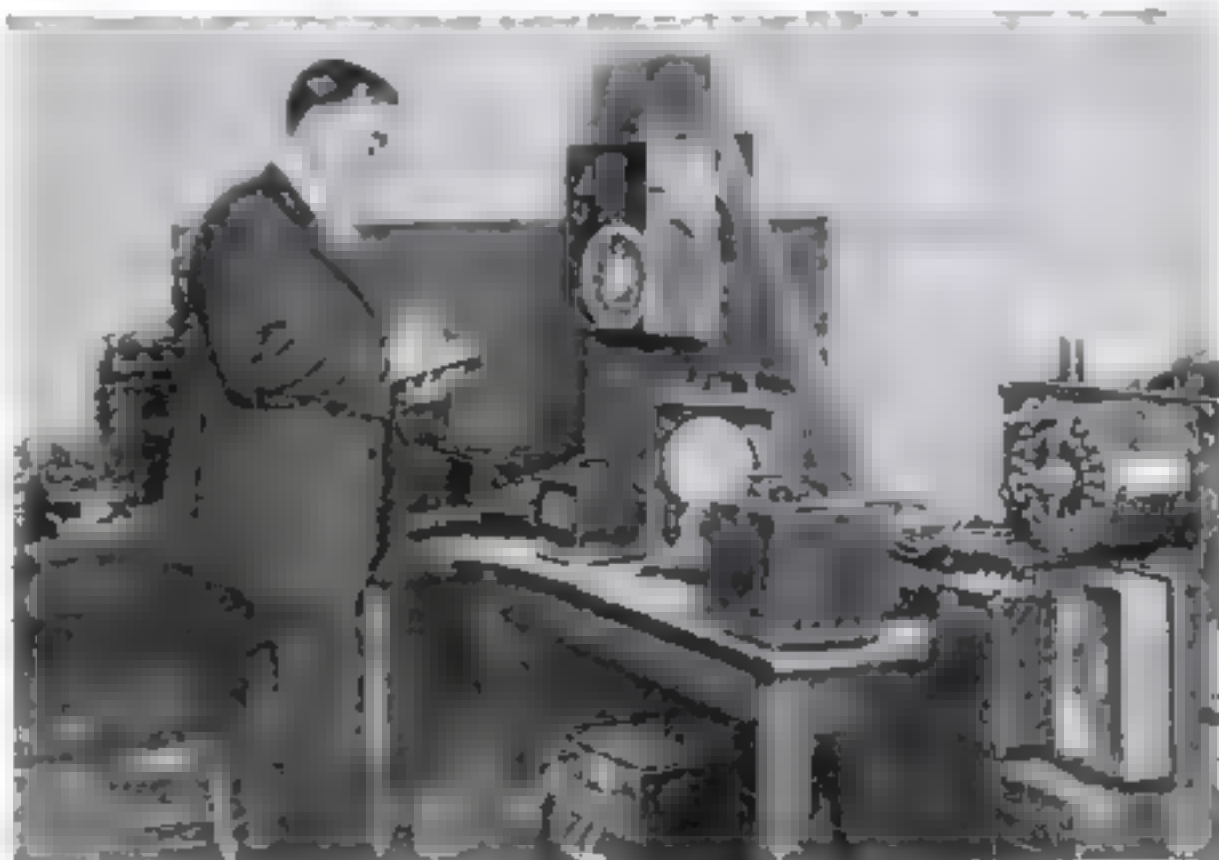
Loudspeakers present peculiar problems all their own. Here the silent testing must cease. A receiving set yields electric impulses that the eye can read on instruments, but a loudspeaker delivers sound alone. How could it be measured?

The human ear doesn't hear all sounds equally well. Just as the eye sees some colors brighter than others, so the ear hears sounds of a certain pitch better than others. A loudspeaker perfect in theory, that shot out all tones equally loud, would not sound uniform to the ear at all!

So the workers at the Institute resolved to find some

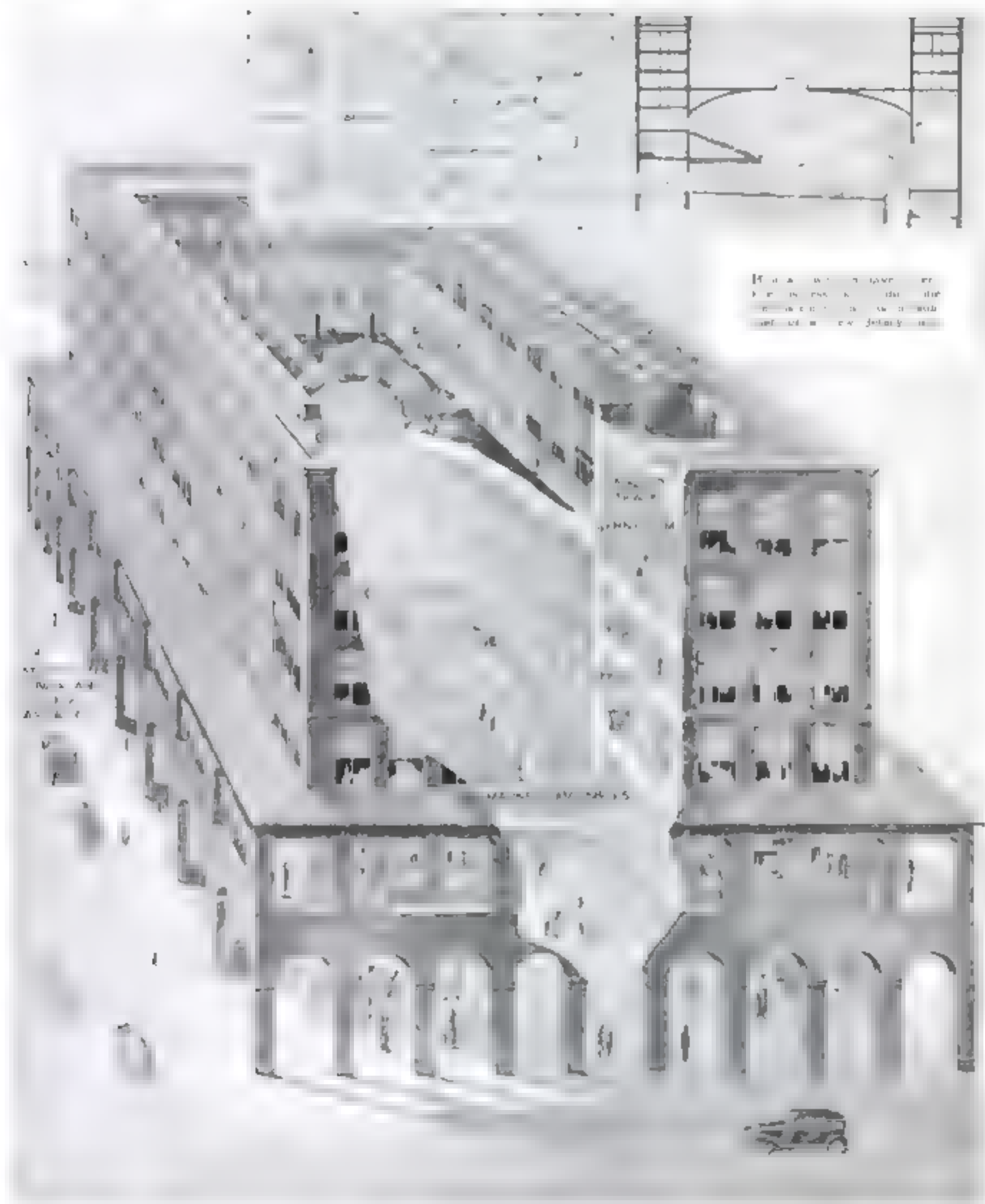
test that would depend on the ear alone. Telephone engineers, they knew, sidestepped the difficulty with what they called "trans-

(Continued on page 140)



Radio sets are tested for every conceivable thing—something no other organization does. This elaborate array of equipment tests the life of batteries under the same usage you might give them.

Ingenious *New* Community Building



COMBINING under one roof a town's entire shopping, business and theater district, a novel "community building" is proposed by Joseph Falk, of New Brunswick, N. J. Under the plan, a town could transform its "Main Street" to the inside of this structure and build an attractive residential section around it.

Drawn by our artist from Mr. Falk's designs, the picture shows the huge central theater auditorium, surrounded by two levels of stores. The auditorium is transformed into a dance hall by leveling the sloping floor with hydraulic lifts and removing the chairs. Above are business offices, lodge rooms, and a roof garden.

Such a building, Mr. Falk estimates, having a 120-foot front, would not cost more than \$300,000 to build—a profitable investment in town beautification, repaid as well by the economy of central heating and maintenance. Store deliveries would be made through a single service department.

Touring the Country in a Tree Trunk



World's Largest Lock Gate

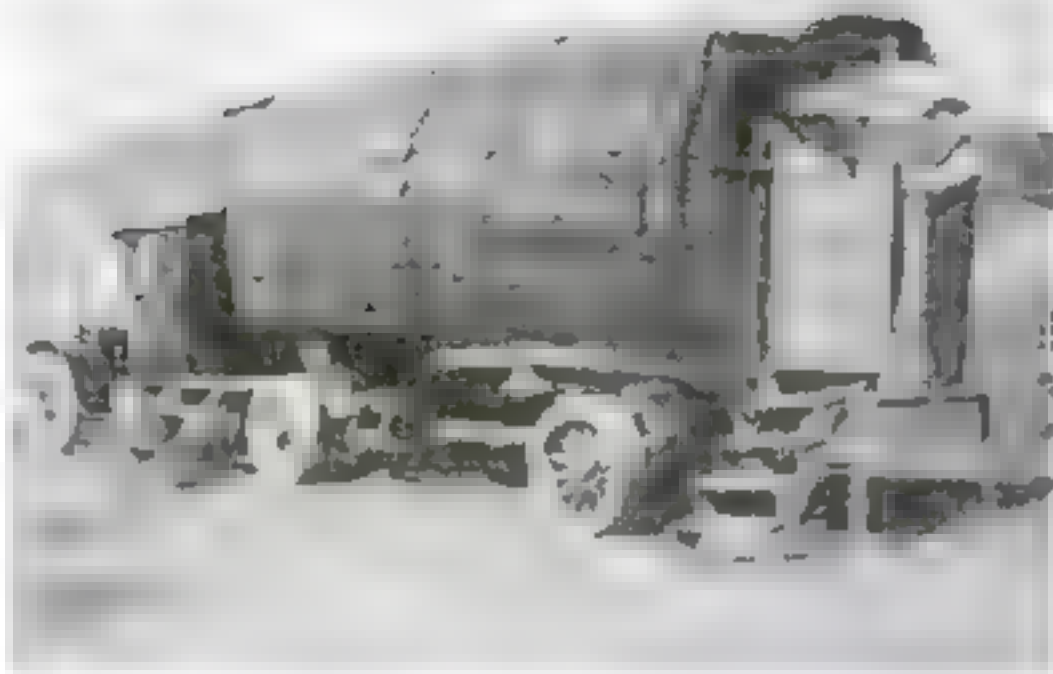
MORE like a skyscraper in appearance than a gate, this mighty structure is one of the leaves of the lock gate that soon will close the river entrance to Liverpool's new dry dock. When completed, the dock of the great English port will be one of the finest in the world—and this lock gate the largest in existence.

Russia's Superpower Project

RUSSIA will have the largest hydroelectric plant in Europe if plans recently announced are realized. Built on the banks of the Dnieper River the plant will have a capacity of 630,000 horsepower, surpassed in this country only by Niagara. The Soviet government has retained Col. Hugh L. Cooper, who designed the Wilson dam at Muscle Shoals, as chief consulting engineer for the project. Other projects, of smaller size, will be additional links in Russia's superpower chain.

Beating the Housing Shortage

A PLOT of ground in France—at least in Paris—costs more than an old puntoon boat and the same area of water—so a Paris workman built this neat two-room bungalow, pictured at the right, for his small family on an old boat abandoned along the Seine River. Just now he is anchored opposite the Louvre museum of art treasures, but when he wants a change of scenery from his bathroom window, he'll cast off and float away to a different location.



WITHIN the giant hollowed-out trunk of a Douglas fir, mounted on a motor truck, Mr. and Mrs. E. A. Wade and their son of California, are touring the country. Their novel temporary home is a modern two-room apartment that contains all the comforts of home—built-in breakfast nook, cupboard, wardrobe, even electric light and an oil stove for cooking. Two beds that fold against the wall provide ample sleeping accommodations. Mr. Wade undertakes the tour to lecture on lumber conservation.

New Element Isolated

AFTER a difficult refining process, Dr. Walter and Ida Noddack of Berlin, Germany, discoverers of the new chemical element rhenium, have succeeded in obtaining and testing two milligrams—seven one-hundred thousandths of an ounce—of the precious substance. Their first report of the discovery of the new metal was based upon

lines detected with the camera and spectroscope in the X-ray spectrum of platinum ores. A black powder of high melting point, rhenium is chemically active. Placed in a vessel of pure oxygen gas, it ignites spontaneously, leaving as ash a white oxide. It combines readily with other chemicals.

Science Weighs a Mountain

SEeking to discover the mysterious forces that hurl molten lava from the crater of Mauna Loa in the Hawaiian Islands, scientists now propose to weigh the entire mountain!

It is impossible, of course, to devise scales to weigh a mountain peak which reaches down some three miles under the sea. Instead, the scientists will use a swinging pendulum suspended from carefully leveled supports to determine the intensity of the earth's gravity from place to place on the mountain. From variations in this intensity, they expect to discover whether the inner core of the volcano is lighter, so that it rises in seeking an escape, or whether other forces are responsible for the eruptions.



Rents and landlords no longer worry the thrifty Frenchman who built this bungalow boat.

Railway Train Built from a Flivver



THIS odd locomotive starts with a crank. Once a flivver but now, with flanged wheels, a one-car train, it runs on the regular tracks of the Tabor and Northern Railroad between Malvern and Tabor, Iowa. Only rarely, when traffic is unusually heavy, is it replaced by a steam train. Even the signals on this line are out of the ordinary—an arrow shows which way the switch is turned.

How the Moon Affects Quakes

THE moon exerts a direct influence on earthquakes, points out Prof. H. F. Reid of Johns Hopkins University, as a result of recent investigations. Just as it pulls on the sea to form the tides, the moon strains on the earth. Should a "fault" or slipping of rock be about to occur for any reason, in a given direction the moon in one position would hasten it, in another, it would delay it.

Device Takes Telephone Messages

SOON it may no longer be necessary to stay at home in order to receive telephone messages. A new Swedish invention answers the phone, takes the message, and repeats it to you when you return. The apparatus has been under test for several months and is now re-

ported to have passed all tests.

When a call comes in to a telephone equipped with the device, the apparatus sounds two bells to indicate that no one is home, and a message must be left. Then it records the caller's voice, as he gives the message, on an unbreakable and inexpensive phonograph record, composed of a highly sensitive material coated on cardboard. Play the record when you return, and you know who called and what he wished to say.

Aluminum Made from Clay

COMMON clay now is to yield aluminum, in Germany, by a new process made commercially practicable by the phenomenal increase in the use of aluminum throughout the world. In the process the aluminum compounds are dissolved from the clay by means of powerful acids—a process made economically remunerative since the discovery that silica, a by-product of the new process, is valuable in many industries as a catalyst in the form obtained when aluminum is isolated. Although this scheme has long been possible in the laboratory, it has never before attained a commercial scale.



Leviathan Gets a New Dress

THERE is more to a great ocean liner than generally meets the eye—witness this unusual photo of the *Leviathan*, taken recently at South Boston, Mass. Put in dry dock for a fresh coat of paint, the ocean monster lies with the whole of its enormous hull exposed. Note the relative size of the pygmies at work with paint and brush below the water line.

Wool Made from Pine Needles

CHIMICALLY treated pine needles are being made to yield a useful substitute for wool in Germany. In the process the resin is chemically removed from the needles, leaving a "pine wool" of fine strong fibers resembling hemp. This wool is woven into heavy fabrics.

The resin by-product is a valuable fuel. Shaped into briquettes, it has a high heat value and has been used in the manufacture of artificial illuminating gas.

An Air Fleet Goes to War

LIKE dragon flies on a floating piece of driftwood, twenty-five planes perched on the upper deck of the aircraft carrier *Langley*, pictured at the left, as it cruised along the California coast to take part in the fleet's recent battle maneuvers. The photo gives a striking picture of how a modern airplane carrier would look, sailing forth equipped for war. Note the corral-like enclosure on the landing deck above, and the unusual position of the ship's smokestacks, made necessary by the floating landing field. Additional planes are carried on the lower deck and in the hold.



The airplane carrier *Langley*, loaded with planes, speeding to the fleet's recent battle maneuvers.

A 10,000-Watt Sun for Airplane Landings



GENERATING such terrific heat, when lighted, that a special glass had to be developed, huge 10,000-watt incandescent lamps are being made by the Westinghouse Company to light airplane landing fields at night. A single bulb, inclosed in a device similar to a light-house lens, is said to be sufficient to illuminate an airport runway 2,000 feet long. The new lights are intended to supplement the high-intensity searchlights now used on the fields.

In the illustration, an engineer of the company is explaining its features to Government officials.

Now—Ball-Bearing Trains

A STANDARD size Pullman car so frictionless that two men can pull it along the gravel rails, is the marvel made possible by new roller bearings for car wheels, replacing the present friction bearings. After a try-out on the Chicago, Milwaukee and St. Paul Railway, the bearings are being placed on more than a hundred cars. The first time that complete sets of passenger train wheels have been equipped with roller bearings.

In one test, a coach equipped with the regulation friction bearings commenced to move when the locomotive exerted 3,000 pounds of force. Another coach equipped with the new roller bearings took only 500 pounds force to start it.

A 20-Inch Cigarette Holder

LONG-RANGE smoking is possible with the novelty cigarette holder below. Twenty inches long when extended, it telescopes to four inches to slip into a pocket. There's no danger of getting fumes in the eyes, either



You'll Soon Be Phoning This Way!

TWENTY million telephone receivers and transmitters now in use in the United States are gradually to be replaced by a new type of telephone, pictured above, combining receiver and mouthpiece in one. Patterned after the European-type phone, the instrument is the product of experiments by the Bell Telephone Company and is said to be an improvement on the Continental type.

It is easy to use—simply lift the phone off its rack, as shown above, and hold it in position at mouth and ear. Replacing it on the rack shuts it off. Its convenience is obvious, and, being only half as high as the present desk telephone, it cannot be knocked over so easily.



Corner Subways for Pedestrians

PICTURED above is the entrance to one of thirty-nine tunnels that the city of Los Angeles, Calif., has built at its most dangerous street crossings, to make it possible for persons on foot to cross the street in safety. Children on their way to school in particular, are protected from the growing stream of motor vehicles that make the crossings perilous, and where these tunnels are built, the "stop crossings" usually provided for school children are eliminated. The tunnels are walled, floored and roofed with reinforced concrete, finished with cement, and are about four feet in width. Their street openings are partly enclosed by cement curbing, to keep out water.

Although pedestrians are not obliged to use the concrete safety tunnels, most of them do, and it is said that accidents have become almost unknown wherever they have been installed.

Airplane Engine Fits in Pocket

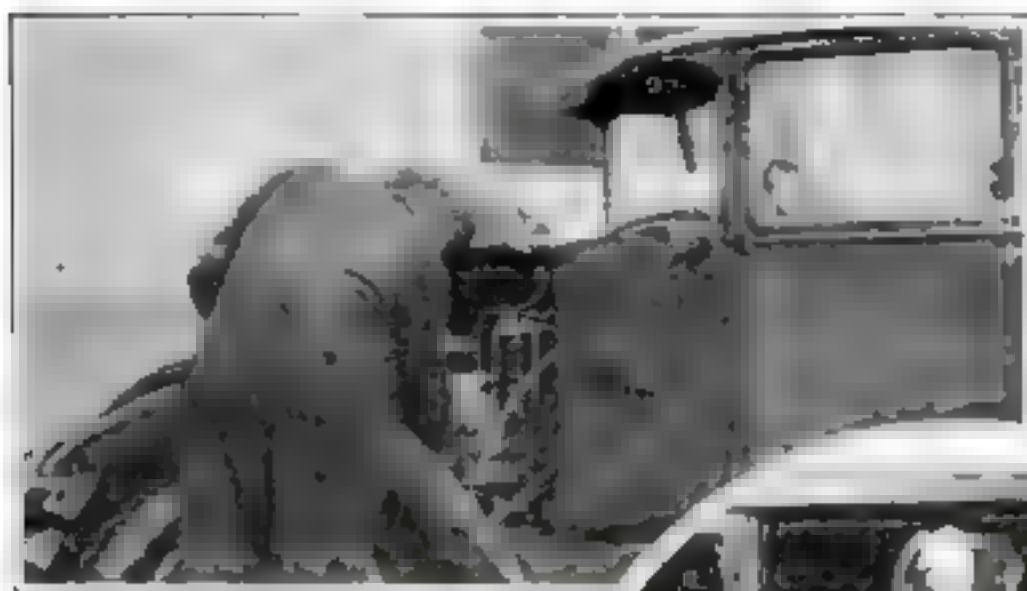


BABY brother of the giant motors that drive great planes, this remarkable motor—and it actually runs—would fit in a capacious overcoat pocket. A two-cycle engine, it develops a quarter to half a horsepower to drive a small-scale propeller that air-cools it. Bore and stroke are only one and one half inches.



In using a cool stroke—extended, this holder measures twenty inches; it collapses to four.

Handy New Aids *for* Autoists



This new work set consists of a number of tools which will help you in the repair and garage work. The tools are made of high grade steel and are designed for the most efficient use. Another feature is the cover which is made of heavy rubber and will protect the tools from rust and damage.



J. G. Chapman & Bangor, Maine. This new work set is made of high grade steel and is designed for the most efficient use. Another feature is the cover which is made of heavy rubber and will protect the tools from rust and damage.



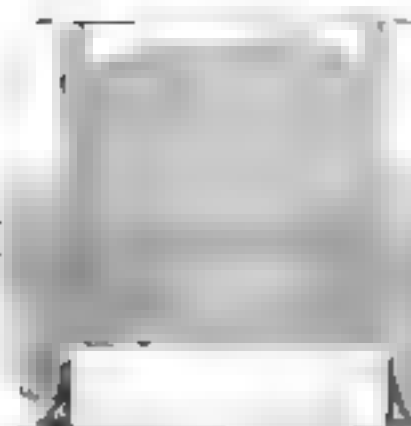
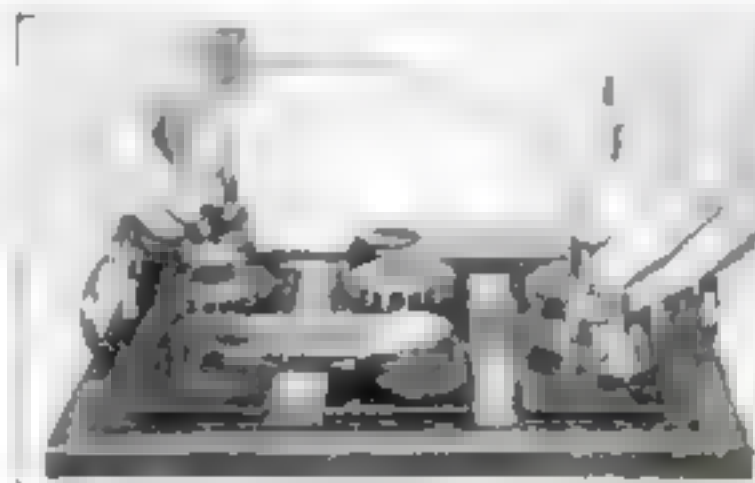
The internal structure of this part is made of high grade steel and is designed for the most efficient use. Another feature is the cover which is made of heavy rubber and will protect the part from rust and damage.

A new type of car part is shown in this illustration. It is made of high grade steel and is designed for the most efficient use. Another feature is the cover which is made of heavy rubber and will protect the part from rust and damage.

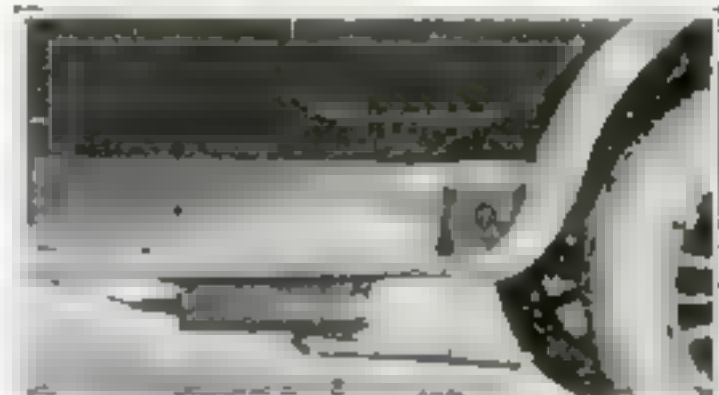
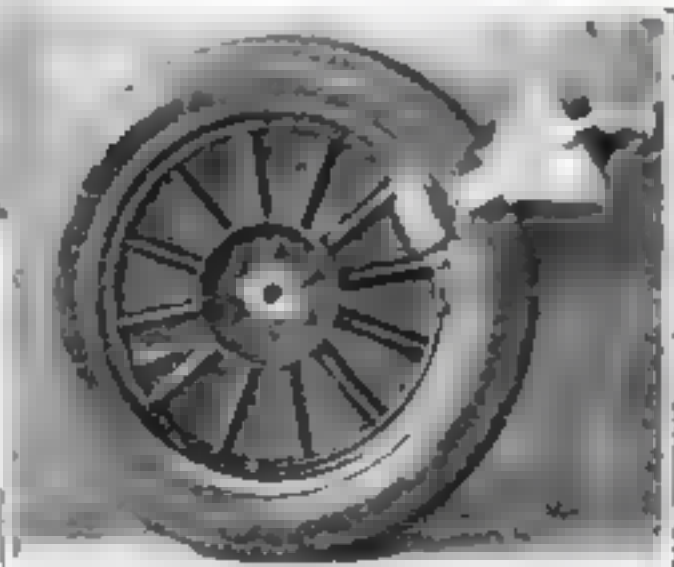


This new type of car part is shown in this illustration. It is made of high grade steel and is designed for the most efficient use. Another feature is the cover which is made of heavy rubber and will protect the part from rust and damage.

A new type of car part is shown in this illustration. It is made of high grade steel and is designed for the most efficient use. Another feature is the cover which is made of heavy rubber and will protect the part from rust and damage.



With a special socket set you can work on the wheels of your car. The set consists of a number of tools which will help you in the repair and garage work. The tools are made of high grade steel and are designed for the most efficient use. Another feature is the cover which is made of heavy rubber and will protect the tools from rust and damage.



A new type of car part is shown in this illustration. It is made of high grade steel and is designed for the most efficient use. Another feature is the cover which is made of heavy rubber and will protect the part from rust and damage.

Thinner Buildings, Wider Streets, for Future City



FUTURE urban buildings must be taller and thinner and occupy, relatively, less space as compared with streets, in the opinion of a New York architect, Raymond Hood. He would solve traffic problems of great cities by allowing six times as much space on the ground to streets as to buildings. Recently exhibited in New York, a model he has made to illustrate his plan shows how a city of low roofs might evolve, by careful planning and easy stages, into a city of isolated towers. In the illustration, Mr. Hood (left) is explaining the details of his novel idea to a fellow architect.

KNOW YOUR CAR

SAFETY in driving an auto at night depends largely on your headlights. When you get away from the brilliantly illuminated city streets, if your headlights should go out at a critical moment, perhaps going around a sharp turn, almost anything in the way of a serious accident might happen.

Of course, since you have two headlights, the chances are small that both bulbs will burn out at exactly the same instant. The chances are equally good that both lights will never go out at the same time through a leakage in the individual wires to the headlights. The most vital point, therefore, is that part of the wiring from the battery through the switch to the point where the headlight wires branch out. Observe these precautions, then, to insure safe night driving:

1. Inspect the battery terminal connections at regular intervals.
2. Make sure that the wire connections to the lighting switch are tightly clamped.
3. Look over the wires occasionally to see that they are not becoming chafed or worn through at any point.

Sunspots Cause of Wars?

PERHAPS astronomers of old were not completely wrong in their belief that the course of human life depended on the stars. Prof. A. L. Tchervsky of the Moscow Astronomical Observatory recently predicted "great human activity of the highest importance which may change the political chart of the world, as a result of the expected three-year period of intense sun spot activity that commenced this year."

Intense sun spots tend to excite human nervous systems, says the professor, and arouse masses of people to extraordinary activity. Most great wars and political crises, according to him, have occurred during periods of maximum sun spots.

A Noted Golfer "Tests Himself"



WILLIE MACFARLANE, former U. S. open champion, ran up a list of a few new set of hazards and tests for himself on the golf course at the University of California. One series of tests ranged from a test of the delicacy of touch to plunge a pointer in rapid succession through three holes without touching the sides. Each "miss" makes an electric contact. Dr. Johanson holds the stop watch. Upper illustration, measuring fatigue of fingers from pulling on a weighted cord in time with a metronome.



Wisconsin's Champ Whittler

OUT of a single piece of wood, Fred Hecker, of Platteville, Wis., carved each of the intricate pieces spread on the table. Some of them, pulley blocks and other gates are among them, all of them designed by himself.

Canadian Police Signal System

WHEN Montreal's chief of police wishes to speak to a policeman or detective anywhere in the city, all he has to do is give a word to his desk operator. A moment later flashing lights on top of all the poles of the policeman's beat summon him to a phone, or give him orders through a unique numbered code.

This is only one of the remarkable features of a police signal system the city has just installed. The moment an officer places his key in a police box, a bell starts ringing at headquarters. He need not even open the box in order to call the patrol. The operator can summon him back after a routine call by a buzzer audible 200 feet away. All calls are at first automatically received on a paper tape that shows, by perforations, why they were made.

In an emergency, the system transmits away from loss of time a message to the radio room, where a force of police can be sent all to a box in the heart of the district.



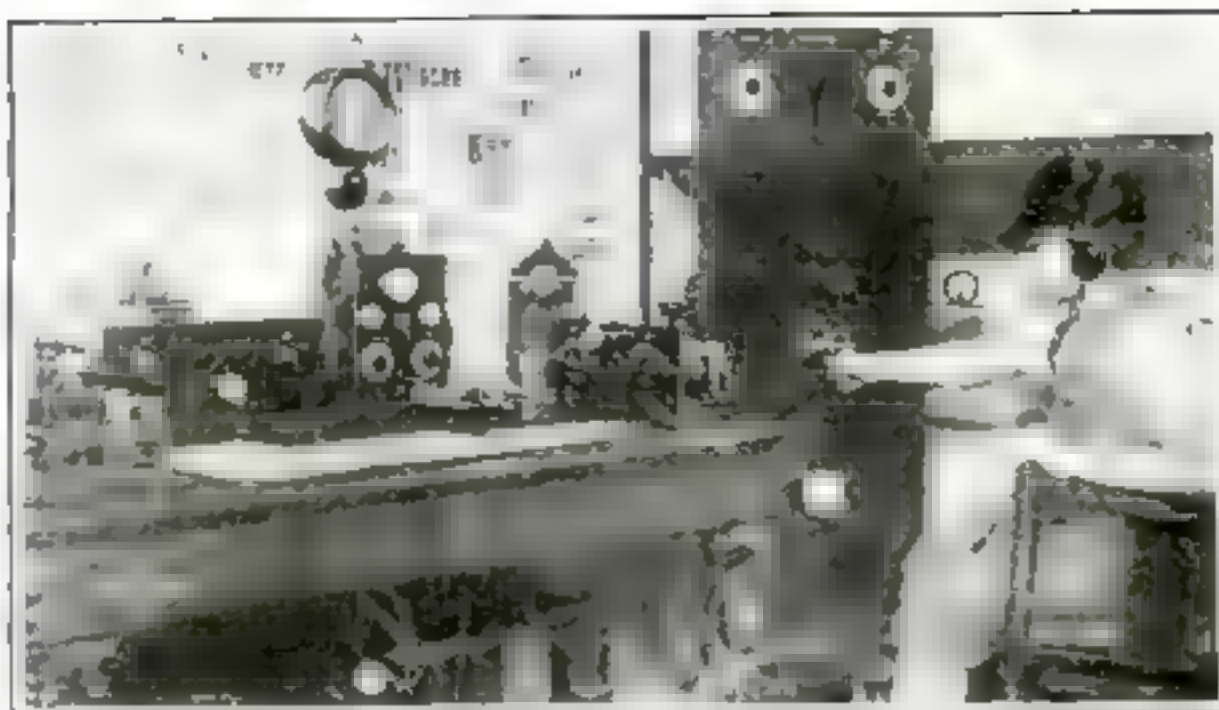
Two of MacFarlane's tests. Above, trying to plunge a pointer in rapid succession through three holes without touching the sides. Each "miss" makes an electric contact. Dr. Johanson holds the stop watch. Upper illustration, measuring fatigue of fingers from pulling on a weighted cord in time with a metronome.



Pygmy Hunter Back with Trophies

BACK from the wilds of Bute, New Guinea, Prof. Matthew W. Sterling, of Berkeley, Calif., leader of the Smithsonian Pygmy expedition, recently returned to report the discovery of a new race of pygmies. Strange animals and plants of the tribe, a few of which are shown above, were brought back.

THE NEW COMET was discovered this year, an unrecorded heavenly visitor was sighted recently by Prof. Carl Lampl, of Wesleyan University, through the twenty-inch reflector at the Van Vleck Observatory, Middletown, Conn. Of only the tenth magnitude, the comet was visible without a small telescope and



12 Years Old, Runs Radio Station

YOUNGEST licensed radio broadcaster in the United States, Robert Marx, of New York City, converses with Europe every evening from his station WJZK. Only twelve years old, he sends code signals at amazing speed. His wave length is forty meters, and his call letter is familiar all over the world. The illustration shows him at the main switch of his one kilowatt transmitter. On the wall are call letters of stations he talks with.

Heartbeat Like Cannon's Boom

TWO hundred medical students at the University of Pennsylvania had the startling experience the other day of hearing patients' heartbeats, at a distance of ten feet, come to them like the booming of distant cannon. The sound was made audible by a wonderful new electric stethoscope capable of magni-

fying heart noises 300,000,000,000 times! If the energy of a pocket flashlight could be magnified to the same extent, it would develop more horsepower than all the electric generating plants in the world.

This instrument, a product of the Bell Telephone Laboratories, combines a stethoscope with an amplifier and powerful loudspeakers, revealing in startling fashion irregularities in heart action. Thus, when applied to the heart of one patient, the noise resembled the rumbling

New Steel Defies Nicks

A NEW steel, said to be eight times harder than any of American manufacture, has been developed by the Federal Krupp works of Essen, Germany. Demonstrated recently in this country, it wore smooth the edges of steel files used in unsuccessful attempts to nick it. A cutting tool made of the new alloy severed elegantly the neck of a glass bottle.



Violin Maker's Jackknife Art

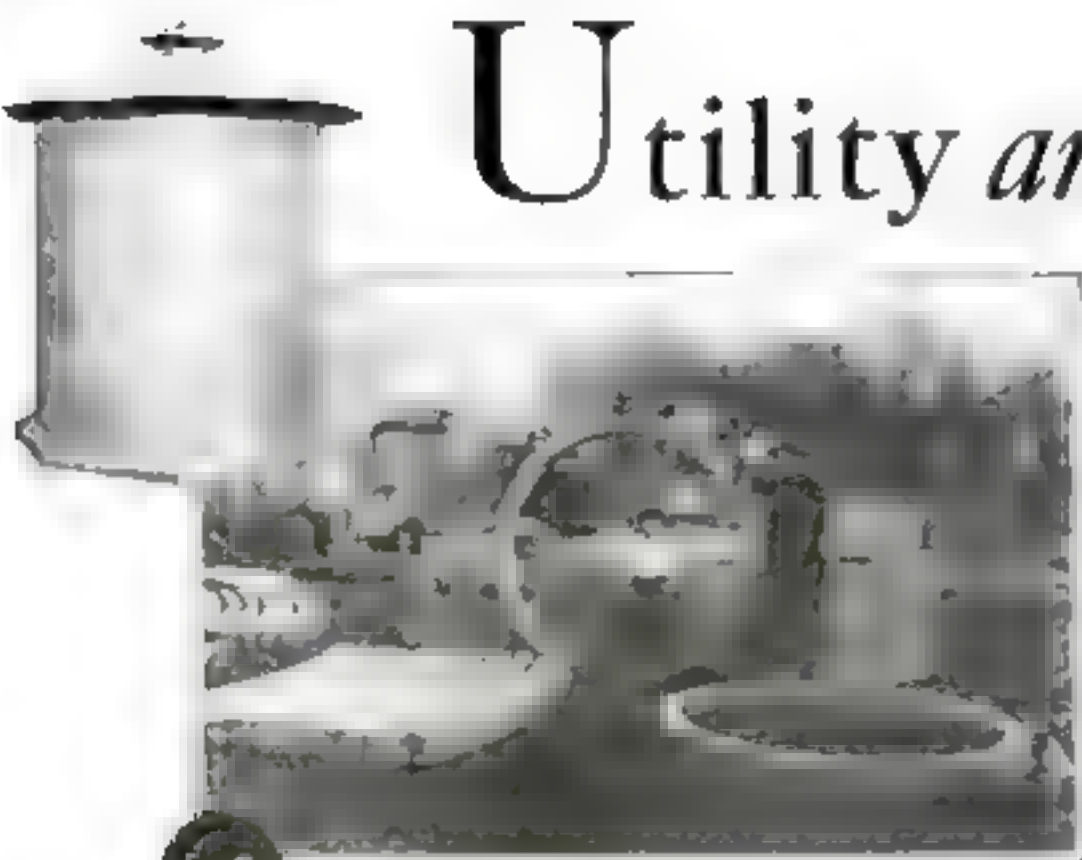
WITH no other tool than a knife, Moise Potvin, expert violin maker, carved out of wood this remarkable detailed picture of a scene in his workshop. Like the familiar Swiss wood pictures, carved and framed in much the same fashion, the charm of his work lies largely in its faithful reproduction of such homely detail as an umbrella, coat and hat, and pictures on the wall. A neat-by-bunching can be seen through the window.

How Much Do You Know of the World You Live In?

TEST yourself with the twelve questions below, selected from hundreds sent in by our readers. For the correct answers, turn to page 144.

1. What famous harbor occupies the crater of an extinct volcano?
2. What famous trees live only on one small peninsula?
3. Who were the mound-builders?
4. Why do houses in Bermuda have whitewashed roofs?
5. Why are Panama hats made only in one part of the world?
6. Where are Roman skin-covered boats still in use?
7. What are the floating islands of the Nile?
8. How were the hanging gardens of Babylon supported?
9. Where are monkey ashes used for medicine?
10. Where does most tin come from?
11. Who began irrigation?
12. What is the difference between the White Nile and the Blue Nile?

Utility and Ingenuity



Molded concrete rings make smokestacks, cisterns and similar circular structures in a new system of concrete construction invented by Hans Bovenman, of Beervle, Tex. Placed one atop another the 470-pound rings built cistern at upper left



With make believe motor, spark plug, carburetor and gas tank, this toy cycle for children is propelled by foot pedals



Waterproof suits, distinctly chic in appearance are the latest adaptation of the new rubberized fabrics. Intended for summer wear to anticipate sudden showers that would ruin another suit they are made of lightweight treated fabric said to be comfortable to wear and impervious to water besides



Invalid chairs are now motorized in Germany, eliminating wearisome hand propelling. From his comfortable side car seat the invalid driver steers his three-wheeled chair by a long lever

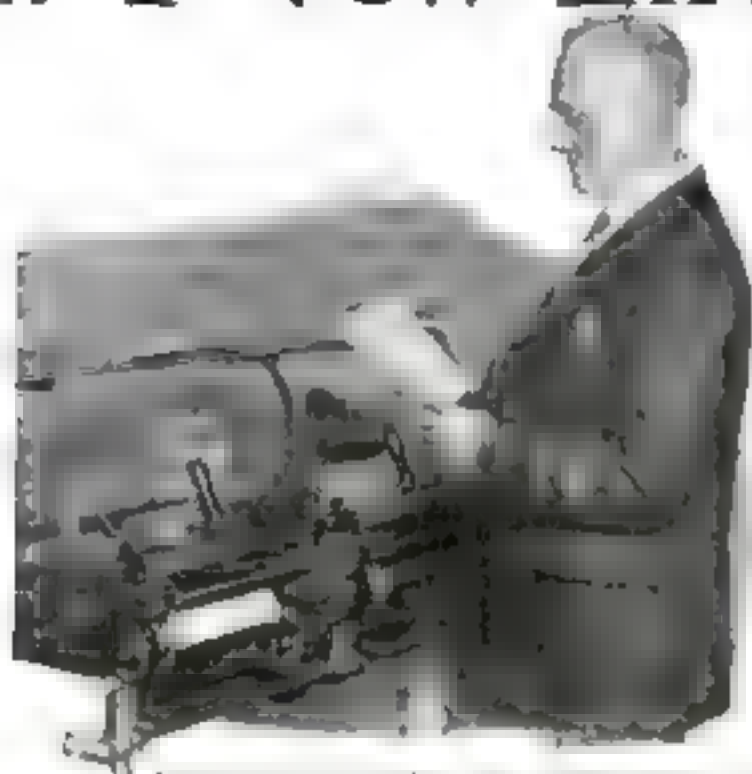


In this newest indoor golf game, an eighteen-hole "links" is laid out on a table somewhat like a billiard table. Billiard cues replace golf sticks, and the "ball" is a heavy disk the size of a silver dollar. While he makes an effort to sink the disk into the cup-shaped "holes," the indoor golfer encounters many a "hazard" - obstacles that bar approach to the holes



Taking such waste materials as ashes, shavings and peat, Johann Ludwig, of Vienna, compresses them into bricks reported to be of high heating value as fuel

in New Inventions



Hundreds of copies of a criminal's finger prints are turned out rapidly by this duplicating machine, invented by Lieut. William Burns of Baltimore. The new device works like a mimeograph machine.



A tenth of a thousandth of a millionth of an ampere—that is the current that this amazingly sensitive new electric measuring instrument can record. The device is used in tests on electric lamps.



(Upper picture) Close-up view of the new electric measuring instrument known as a "thermionic microammeter."



A phonograph that plays for a full hour without attention? This latest development in talking machines is made possible by a device that automatically feeds twelve records to the turntable from a magazine, with half-minute stops between.



Invented to aid a lone night watchman on a Boston trolley, this combination lantern and support for the lantern, can be waved to signal a train, and can be spiked into the ground if desired.



Cigarettes and matches go together in this ingenious new combination case. In the bottom of the leatherette pouch is a holder for safety matches. The top holds a package of cigarettes.



Monkey wrenches in the hands of three men put this "permanent but portable" house together in eight hours. Walls of insulating fiber are screwed to a frame of steel rods, the exterior is slatted and interior coated with a special composition.

Krupp Works Turn to Peace

VAST workshops that once made guns and shells to destroy human life have now turned to peacetime products at the giant Krupp works in Essen, Germany. The illustration at right shows a corner of this famous war factory as it is today with magnificent instruments lined up awaiting shipment. These, with motor trucks, now are the main product of the plant after

the last war. With world peace, the production of these instruments has ceased.



Scene in the Krupp works in Essen, Germany, where now war instruments are made.



Color Piano Has 6,000 Lamps

HARMONIES of color to accompany orchestral music are created by a remarkable "color piano" perfected by Leo Graslund, of Los Angeles, Calif. With one hand working the ten keys of his instrument's keyboard, he creates flashing images of purple, red and orange from 6,000 concealed electric bulbs. His other hand throws switches that control the banks of lights.

Certain color combinations or "chords" are said to have a particularly emotional appeal, heightened by music. Future compositions in color for the light-flashing piano might be written in modified musical notation, Graslund, however, plays his instrument by ear, or rather "by eye."

New Giant Dirigibles

THE Zeppelin factory in Germany has started construction of the aluminum frame of a huge airship designed for weekly trans-Atlantic passenger service between Spain and South America. This giant liner will carry 100 passengers, crew, luggage and mails. Eight large compartments will be fitted with every modern luxury. It will be completed in September.

Meanwhile, Uncle Sam's project for two super-airships, each of 6,000,000 cubic feet capacity, has been clouded by worry as to how they can be inflated. America faces a shortage of nonflammable helium gas. There never was enough to float the *Shenandoah* and



The color pianist at his instrument and (left) the electric equipment, including 6,000 lamps, with which he produces his effects.

Los Angeles at the same time and each of the new dirigibles will require three times as much helium as the *Los Angeles* now uses.

Also, the chief source of helium supply in natural gas at Petroleum, Texas, is failing. To remedy the situation, a new supply will probably be developed from helium-bearing gas at Naruna, Texas.

Quartz Motor Run by Radio

RUN by radio, a novel electric motor described by Dr. Alexander Meissner, German radio engineer, has as its rotating part a small plate cut from a quartz crystal. Placed in a radio circuit, the crystal vibrates and sets up air currents that cause it to spin. Too weak to be of practical value, the motor is, however, being studied with interest by scientists. Quartz vibrations in a radio circuit, they point out, have another interesting application in keeping broadcasting stations exactly on a proper wave length.

Fight Shipworms with Paraffin

WOODEN wharves, ships and houses are now being protected against shipworms by a special paraffin treatment developed by Dr. Paul Bartsch, marine biologist of the U. S. National Museum. The process consists of impregnating the

wood with paraffin and two kinds of poisons, one to destroy all attacking animal life, the other, parasitic plants. Blocks of wood treated with the new compound have so far been kept under water for two years without being attacked by shipworms.

The paraffin treatment is now being tested for its efficacy against land armies of ants and bacteria.

Navy Mapping Southern Seas

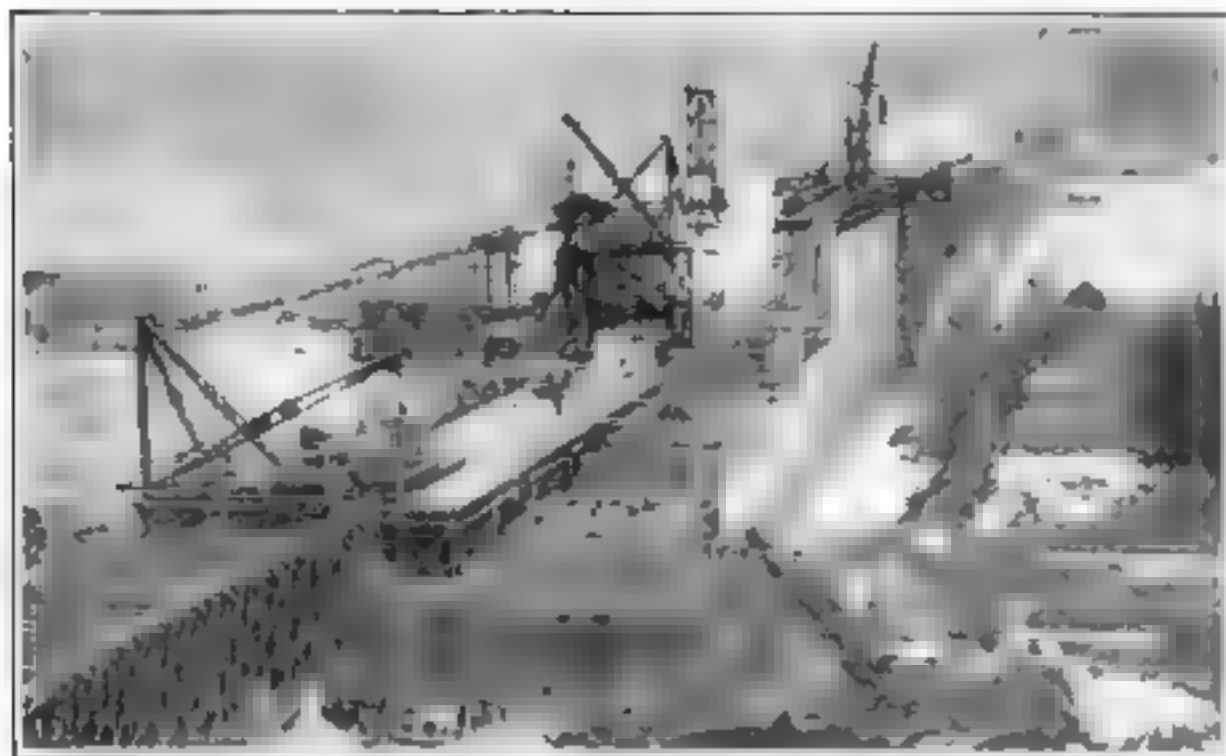
AIRIAL cameras and sound depth finders are being used in a new survey of the areas of seas off Central America and Central Asia, conducted by the Hydrographic Office, U. S. Navy. Surveys, begun by old and navigable charts of the region, begun some dating back to the sixteenth century, will be provided with up-to-date, reliable data as a result of this expedition.

Three ships and two amphibian planes are making the survey. On shipboard an observer operates the "sound depth finder" that projects a sound wave to the ocean bottom, while through his earphones the returning sound tells him how deep it had to go before it was reflected. Airplanes, meanwhile, photograph the coastline from above.

Bees Stupid, Scientist Finds

BEEES haven't any common sense at all, says a French scientist, J. G. Millet. Instead of deserving credit for their industry and wisdom, he says, they don't even know a good honey-producing flower from a bad one. Experiments have convinced him that a bee is attracted to a flower solely by its odor—it will fly as quickly to a perfumed artificial flower as to a real one. Looking for sugar, it is satisfied that a sweet scent means a meal, and stupidly ignores odorless flowers with stores of honey.

PINK STAINS of mercurochrome, the new household antiseptic, can be removed from silk as follows. First apply benzaldehyde then twenty-five percent hydrochloric acid, finally sponge with alcohol, then with water. Mercurochrome spots should be removed before a garment is dry cleaned, as substances used in the cleaning will leave them indelible stains.



Part of Maryland's giant new hydroelectric plant on the Susquehanna River.

Maryland's Giant Power Plant

GREATER than Muscle Shoals and second only to Niagara's huge generators, this monster power project on the Susquehanna River in Maryland will soon be completed. Seven great water turbine generators will dispatch electricity over a 220,000-volt transmission line to Philadelphia sixty miles away. Nearly a mile long, the huge Colowago Dam across the river is seen at its northern end in the illustration. It will develop 850,000 horsepower—more than the present power at Muscle Shoals and enough to light ten of New York's "White Wards."



Propeller Fins Speed Up Ships

CURIOUS fins attached to the hub of a vessel near its screw propeller are used in a new English invention to increase the boat's speed and lower fuel consumption. With the ordinary form of ship, water flows in an upward direction to the propeller. The new fin device relieves the propeller of the work of making this flow of water move horizontally.

Tests of the device are said to have shown fuel economy, greater speed, easier steering and absence of a stern wake.

Edison Raising Rubber

THOMAS A. EDISON, world famous inventor, sees the great cotton plantations of the South transformed into producers of rubber. With Henry Ford, he has established an experimental rubber plantation at Fort Myers, Fla., where he is conducting remarkable tests with rubber that grows from a "vine" and with special machinery, including a new combination reaper-press.

Edison's rubber seed came from Madagascar, and the vine is a perennial which grows without replanting and can be harvested annually without further cultivation. Both plant and machinery are still in an experimental stage, though so far the vine has successfully resisted cold snaps, even hurricanes.

THE AVERAGE person has about sixteen square feet of skin surface on his body according to the Imperial State Institute for Nutrition in Tokio, Japan.

Carried 50 Miles by Tornado

PICKED up and carried away by a tornado recently, a sheet of heavy iron roofing was found fifty miles away from the scene of the wreck. According to the U. S. Weather Bureau, the tornado tore its passage a schoolhouse at Landolt, Md., and was later traced on the ground for only fifteen miles. It is believed a whirling vortex in the upper air sustained the piece of iron roof on its long journey.

Hormone Makes Hearts Beat

ANNOUNCEMENT comes from Dr. Ludwig Haberlandt of the University of Innsbruck, Austria, of the discovery of a "heart hormone," a powerful chemical compound secreted within the living heart and spurring it to action. This compound is to be classed with the secretions of the ductless glands, such as the thyroid.

Dr. Haberlandt discovered that extracts from the heart of a frog would act on the stilled heart removed from another frog, causing it to contract again. Experiments with the hearts of dogs had like effects. The Austrian scientist believes that the new hormone may prove valuable in medicine as a stimulant to weak hearts.

Twins' Finger Prints Differ

FINGER PRINT identification has again been vindicated. When Prof. William Crowthor of University College, England, recently asserted that George and Edward Ellis, twin brothers, had finger prints exactly alike, police authorities the world over alarmed, appealed for information. Scotland Yard, England's famous detective headquarters, made an investigation and found the twins' finger prints dissimilar. One had "three radial loops and seven ulnar loops," the other "one radial loop and nine ulnar loops."

Comet to Whiz Near on June 26

FOR the first time in a number of years a comet will be visible in the night sky a few weeks from now. The Poey-Wincke comet, which visits us every six

years, has just returned and its return is being eagerly watched by the astronomers. It is expected to be at its closest to the earth on June 26, and will be visible in the evening sky. The comet will be at its nearest—four million miles away, twenty-three times nearer than the sun. We may see it then without a telescope, in the southeastern sky about midnight.

Baby Now Worth \$9,333

THE fact that we live longer than did our grandfathers is bringing us billions of dollars in cash, says a great insurance company whose experts estimate that the total increase in earning power of American men and women in the present generation, or since 1901, is \$3,200,000,000. This gain, they declare, has been due largely to the extension of life.

In 1901, a baby boy at birth was considered to have a potential value of \$7.03. By 1924 this value increased to \$9,333. This gain also, they conclude, is due to the expectation of longer life, with a consequent longer period of earning capacity.

How Cool Should a Theater Be?

UNDER the direction of the American Society of Heating and Ventilating Engineers, women students from the University of Pittsburgh are being weighed and observed in novel tests to find out how a cooling system for a theater should be designed. The girls are weighed on special balances that record a change in weight of one-thousandth of a pound. From these weight changes, temperature standards will be established.



More power to a steamer's propeller—two installations of the new fins which deflect water to the propeller.

Solving Everyday Problems



Golf balls are speedily cleaned by this mechanical washer, and hands aren't soiled in the process. To wash a ball the plunger is moved up and down, while the ball is rotated between twin brushes in a patented slot in the washer.



Intended primarily for military use, a new aerial camera needs no operator, but automatically takes pictures while the pilot maneuvers his plane. On each picture is recorded the time it was taken, the angle of the camera to the ground, and the altitude. Designed by Sherman M. Fairchild (left), above, the camera snaps 180 square miles of territory without reloading.



Strapped on a golfer's wrist an ingenious device checks his swing before driving. At the top of its swing, the golf club has attained considerable momentum. To reverse it the fingers are strained, often spoiling the shot. The leather swing check shown above is designed to eliminate this strain, preventing over-swinging, slicing and hooking.



When a typist taps out a letter on the standard typewriter keyboard of this unique electric machine, she finds it when finished, completely set up in type that imitates ordinary typewriting. Placed in a press, it yields many thousand attractively "typewritten" copies of the original letter. Thus costly typesetting by hand is eliminated.

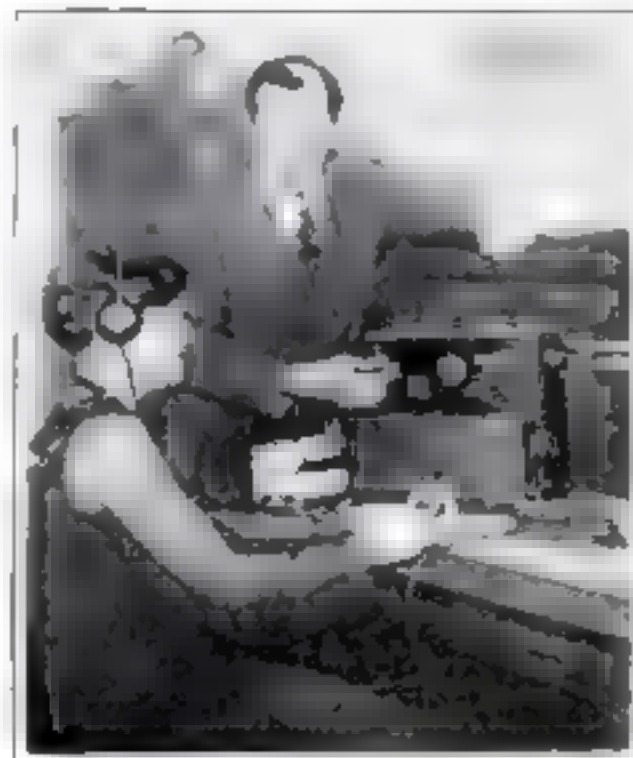


A six-foot measuring stick no bigger than a watch—that is the new metal rule that springs from a small coil to form a stiff, rodlike measuring stick. It is let out to any desired length, and pushes back into its case like a sword in its scabbard.



Slipped over the point of a pencil, this handy device is a letter opener and point protector combined in one. Its flat end for letter opening terminates the pencil point guard. It is kept from turning while in use by a sliding ring that compresses the barrel to grip the pencil.

Aid to the deaf comes in the shape of a new type of electric telephone that looks like a radio set. Twist its dial and hitherto inaudible sounds become strikingly clear. Not portable, it is for installation in homes or offices. The photo at the right shows Dr. C. W. Harper, of Boston, the inventor, demonstrating his new device.



Intercommunicating Phone, Home Bicycle Exerciser, Self-Operating 'Aerial Camera and Other New Inventions



Through shallow shoals where motor boats have never been before, or over ocean billows, this short draft boat skims at thirty miles an hour. Its aviation engine is placed behind the cockpit above the deck, directly connected to the air propeller. The boat drives like an automobile, with all controls on the steering wheel, while the air and water rudder makes steering surprisingly easy.



You can ride miles on this bicycle exerciser without going anywhere and acquire muscle and vigor in the process. A speedometer counts the miles, and a friction attachment on the wheel calls forth any desired degree of effort to spin the pedals.



No more lost buttons—these new style overalls haven't any! Instead, squares of reinforcing cloth, sewn on for good, catch in loops to hold the garment neatly in place. At the waist, a detachable buckle clasps a belt strap, to assure a snug fit.

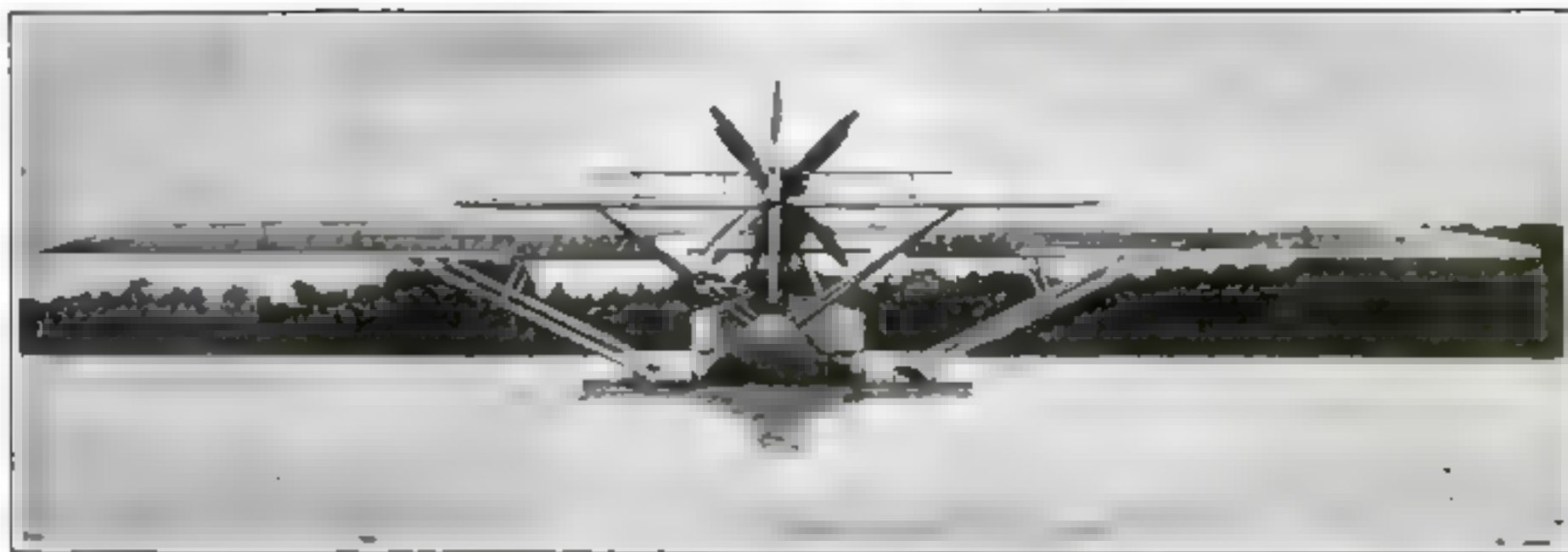


With a microphone at your desk and a loud-speaker at your secretary's, you can give oral instructions at a distance without shouting. Or (this novel) intercommunicating system, substituted for the buzzer, can be installed at home between dining room and kitchen or house and garage. It runs on a six volt dry battery.

Two New York firemen invented this safety lamp, for attachment to the shield of the fireman's helmet when the fire fighter must work in smoky and dangerous places in a dark building. The lamp is lighted by ordinary flashlight batteries. Charles Becker and George A. Timlin are the inventors.



Revolving around the sitter while a shaft of light throws his features in sharp relief from every angle, a new movie camera in a few seconds obtains a graphic motion picture record from which a sculptor can make a statue. Tedious sittings for the sculptor are largely eliminated, besides which the camera will be used to record permanently the features of persons of note throughout the world, for the use of future sculptors.



A real air liner—Germany's 110-passenger seaplane, seen from the rear after its trial flight over Lake Constance.

Plane Carries 110 Passengers

CARRYING 110 passengers, this mammoth seaplane, just completed at Friedrichshafen, Germany, sped over Lake Constance on its trial flight at more than 120 miles an hour. A feature of its construction is the tandem four-bladed propellers, one in front of the single main plane and another just ahead of the rudders. It is shown above from the rear.

Future planes of this type may be constructed to carry huge loads of freight or serve as fleet ocean liners of the air.

Magnetized Area Fine for Radio

OWING to its large deposits of magnetized iron ore, Magnet Cove, about eleven miles from Hot Springs, Arkansas, brings in radio waves with exceptional results. Tests made with sound machines set upon the large boulders of magnetized rock showed that stations were clearly heard at this point that would be received most feebly in other equally distant locations. Further tests are to be carried on.

Magnet Cove has credit for having the largest deposits of magnetized iron ore in the world. In this area a compass will not work. Surveyors cannot use the tools that are commonplace elsewhere. Small rocks of this area, naturally magnetized, have been sold to the laboratories of many colleges and schools.

Plant Redwoods in Virginia

GIANT redwood trees, California's forest monarchs, may appear in Virginia if experiments prove successful. H. M. Bears, supervisor of the national forest at Natural Bridge, Va., is preparing a shipment of California redwood seedlings, to be planted near Natural Bridge. The trees are prized for their lumber, which has great durability.

Flier's Chief Requisite—Nerve

WHY can some men fly safely, others not? What qualities make a good airplane pilot?

The School of Aviation Medicine, San Antonio, Tex., has undertaken to answer these questions. To this end they are aided by a remarkable instrument which tells the speed with which a man reacts to signals in color, light,

and sound, and the speed and coordination of his movements.

The chief requirement of a good flier, according to Capt. Neely C. Mashburn, chief psychologist of the school, is "nerve." To determine a prospective flier's nerve, his personal history is studied carefully. Major Francis H. Poole, chief of the school, recently expressed the belief that ninety percent of accidents are due to the pilot and not the plane.

Why Candy Explodes

SOMETIMES candy explodes, and now and then confectioners find whole shelves of chocolate creams that have burst open. The cause, according to scientists of the U. S. Bureau of Chemistry, is yeast in the sugar filling. Ordinary yeast, like that used for making bread, will not grow in sugar, but there is a special yeast that finds the sweet creamy mixture ideal. Its fermentation produces gas that bursts the candy.



Radio Set for Aviators

A DISABLED seaplane drifting at sea may broadcast an appeal for help with the newest airplane radio, pictured above, designed by the U. S. Navy for just such an emergency. Small and compact, it is operated by a hand generator, and so works even when the plane's

motors are dead. A set of quartz crystals enables it to transmit a steady signal on one of several different wave lengths.

In the illustration the set is seen at the left, the hand generator at the right.

African Bird Fades in Rain

BRIGHTLY colored when the sun shines, the feathers of an African bird recently studied by Dr. I. Krambuegel, German biochemist, become a sad spectacle when wet by the rain. The brilliant dye of its red feathers fades to a pale pink, the leak being caused by the ammonia in rain water. Food the bird eats probably furnishes minute quantities of the natural dye's ingredients, says Dr. Krambuegel. Known as traccie, the dye is a compound containing copper.



Paris Tries Portable Semaphores

PORTABLE traffic semaphores are helping solve the traffic congestion problem in Paris. At specified hours of the day they are moved to street intersections where congestion is heaviest—during the business rush hours, for example—then at night they are carried to the theater districts, and on Sundays and holidays to crowded intersections near the railway stations. The first of the new signals to be tried out is seen above at one of the busiest crossings.



Those who cook their own breakfast will appreciate this compact electric hot plate that prepares a meal in a jiffy. A detachable handle saves space and burned fingers.

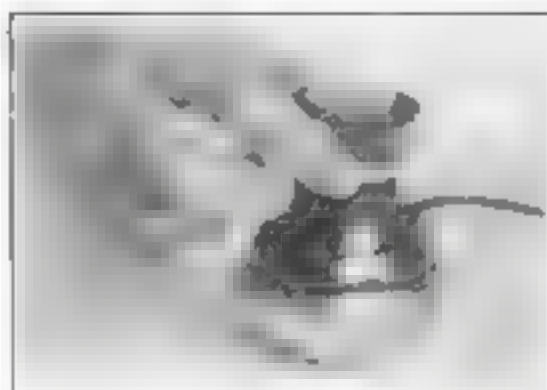


Round, square or oval cans are opened with this ingenious tool. Its two handles grip the can rim with a roller and a cutting wheel. A few turns of a crank and the top of the can drops off clean cut, leaving the food on the can.



Below: Press a button, and this versatile electric device mixes drinks or salad dressings, beats eggs or whips cream. With its adjustable stand it fits bowls of any size. Two sizes of beaters adapt it to a variety of uses.

Tools *that* Lighten Home Tasks



Pick it up and it lights, put down and it goes out. This bowl in reality an electric match can't waste a cigarette for it shuts itself off. Always ready it gives a sign of cigarette safety.

Right: This dish washer brush makes short work of the dishes in the sink. Attached to the faucet by a rubber connector, it can form a soap chamber that adds suds to the hot water flowing in it. The brush is extra wide.



When there isn't much room to space this clothes rack shows its virtues. An unstable in use it occupies little space open, much less closed and it can be taken apart for storing or packing. Light in weight it is easily handled and moved about.



A novel pie crust mixer uses loops of flexible wire to blend shortening and flour in a bowl of any size. Also mixes, chops and creams food.

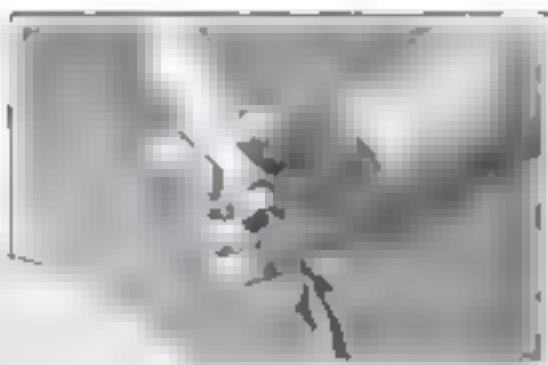
Any bathtub with a standard faucet can now have a shower by the simple attachment of this basket device. A hinged metal arm, clamped to the faucet or to the wall, holds the spray nozzle at the desired height. Rubber hose connects nozzle and faucet.

Two New Dish-Washing Devices, Can Opener, Faucet-Operated Cream Whipper and Other Novel Inventions



With one blade notched and the other straight, these new shears save the family scissors from nicks, cutting picture wire, clothesline, even fish bones, with equal ease.

Below: Silver magically loses its tarnish, placed in a dish and touching a new aluminum plate covered with hot salt solution. The magic used is an electrochemical treatment.



Built for long life, this f-edged can opener uses blade at a time. When is dull the other is ready service. Two built one complete the double life.



Slide back the top of a new kitchen table and out comes an ironing board. Ordinarily hidden beneath the porcelain table top, the disappearing board swings into a convenient position for use.



Milk bottles become pitchers with the attachment of this lid to its neck. Tilt the bottle, press the plunger, and a stream issues from the spout.

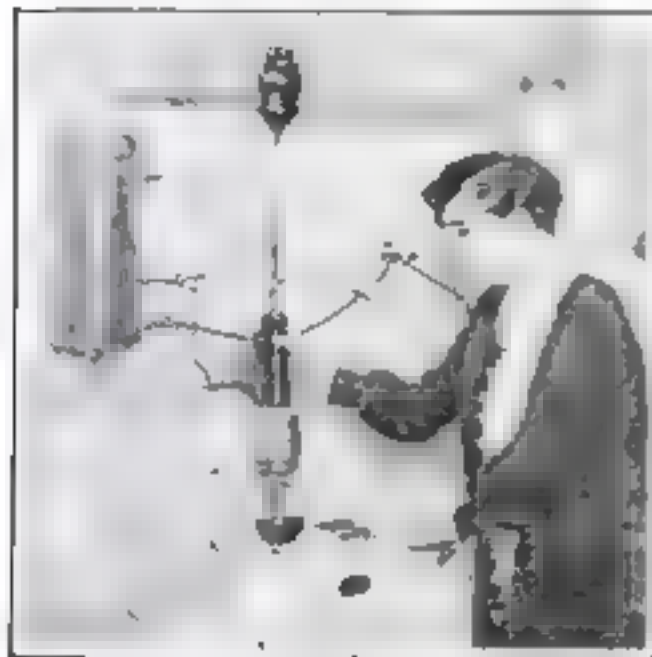


One ten pound cake of ice is made in an hour in this ice making machine for the home. Tip it on its side in the cradle rack and out slides the ice. When no ice is needed, the electric current is shut off.

Left: A graceful new electric hot water boiler, when filled with water, one day and then plugged in. The electric water heater keeps the water warm and healthy.



A re-look to the kitchen faucet and pump is making the water power to be used for beating eggs without cream and so on. It fits any tap and contains a small water turbine that when the faucet is turned, the mixing



While hot water courses through a tube in this novel dish washer, its spinning electric brush is passed by hand over the dishes, removing and scraping all food. The device is hung by a wash cord from a weighted pulley to make it easy to move in any direction.



Dr. Lutz, who has deciphered Hittite writings 4,000 years old

World's Oldest Book at Last Deciphered

hitherto baffling mysteries of ancient civilization.

The tablets were dug up in the ruins of the Hittite capital near Angora, Turkey, with other letters and documents, all inscribed on sunbaked clay and filed away just as a modern business firm keeps its records. The writing was done while the clay was soft. When a tablet was to be sent any distance, powder was sprinkled over the text and the tablet wrapped

in a soft, wet, clay "envelope." The powder prevented sticking, and the recipient broke off the clay wrapper with a thin chisel.

The text, as Dr. Lutz found it under the clay envelopes, was in the cuneiform or dart-like characters of ancient writings.

These natives of the country known

as Hatti, now modern Turkey, the Hittites are disclosed by Dr. Lutz's translation as a sort of "missing link" between Babylonian and Greek culture. Such Biblical tales as that of Moses, Saul and David, as well as the legends of the Iliad and the Odyssey, the origins of which have long been a mystery, are revealed by the tablets to have come down to us from the Babylonians and Chaldeans through the Hittites.

AIDED by a sharp chisel, Dr. H. Lutz, of the University of California, has just finished reading the oldest book known to man. The task has taken him twenty years. The chisel was necessary because the "book" is a series of clay tablets, about the size of a pocket notebook, each incised in a baked clay sheath, which had to be chipped away by the sharp tool. Dating from a period between 2,000 and 2,500 years before Christ, the book is part of the records of the little-known Hittite Empire, and explains



Map of ancient Hittite Empire as reconstructed from new data



Cuneiform writing on Hittite tablets, now deciphered. It is read vertically, top to bottom.



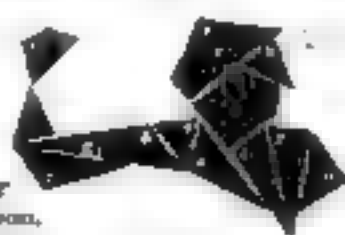
Hittite rock carving, showing Babylonian influence. It represents a priest carrying offerings.

Winners in Our March Stomachion Contest



Baseball Player
Third Prize

Louise S. Lovett, Weaverville, Calif.



The Pitcher

Mrs. C. E. Dickinson, Minneapolis, Minn.

IN OUR March issue we offered \$100 in cash prizes to readers submitting the best original designs on the subject of "sports" made from the fourteen pieces of the Stomachion puzzle game of Archimedes. A number of the prize-winning entries are reproduced here. The prizes have been awarded as follows:

FIRST PRIZE, \$25—Thomas D. Young, Frankfort, Ky.

SECOND PRIZE, \$15—J. J. Leahy, Medford, Mass.

THIRD PRIZE, \$10—Louise S. Lovett, Weaverville, Calif.

Five Prizes, \$5 each

Hurace F. Bell, Erie, Pa.

W. M. Mullins, Richmond, Va.

Karl Steding, Wilkes-Barre, Pa.

E. Scholdknecht, Seattle, Wash.

J. G. Staehli, Des Moines, Iowa

Ten Prizes, \$2.50 each

E. V. Bowers, New Ross, Ind.

Clarence W. Carroll, Rochester, N. Y.

C. L. Crotefield, New Brighton, Pa.

Robert E. Despard, LeRoy, Minn.

Mrs. C. E. Dickinson, Minneapolis

Hattie M. Little, Sebastopol, Calif.

Mrs. Ethel Reed, South Bend, Ind.

H. N. Toftoy, San Antonio, Texas

A. P. Wilson, Peapack, Ont., Canada

Wm. J. La Santa Cruz, Calif.



Tennis Player
Second Prize

J. J. Leahy, Medford, Mass.



Steeple-chaser
First Prize

Thomas D. Young, Frankfort, Kentucky

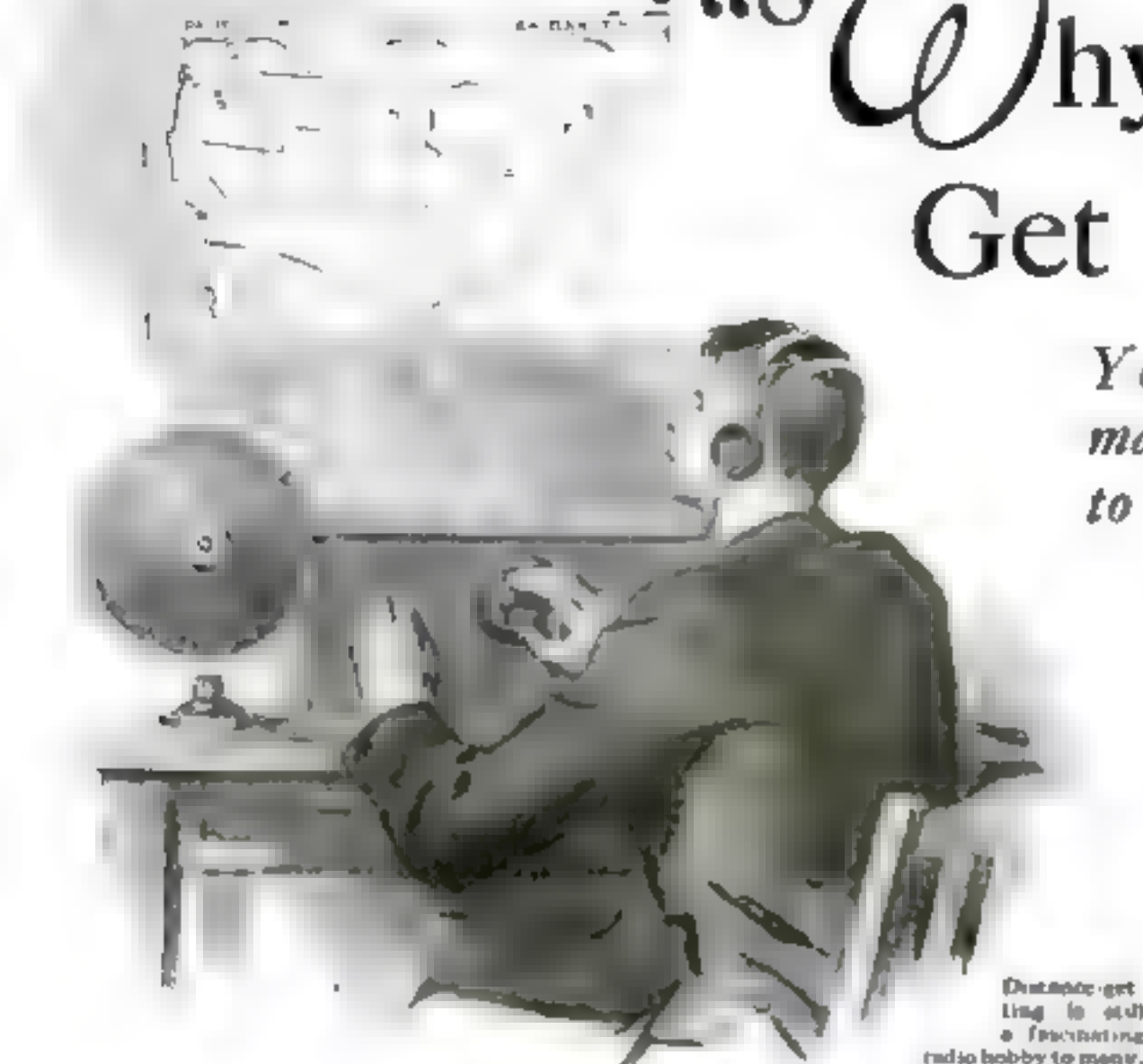


The Runner
Karl Steding, Wilkes-Barre, Pennsylvania

"Why Can't I Get Distance?"

Your set or your location may be to blame—What to do for best results

By
JOHN CARR



Distance getting to still a fascinating radio hobby to many, its uncertainty only adding to its lure.

IT'S all very well for people who live in big cities to claim that radio fans no longer want to listen to distant stations, but the fact remains that a large percentage of radio listeners in this country must either bring in far-away stations in a satisfactory manner or else go without radio entertainment altogether.

If you are one of these—or still feel the fascination of listening to far-off stations, and have difficulty in getting worthwhile results, what's to be done about it?

First, determine the cause of your unsatisfactory results. Faulty radio equipment may be to blame, in which case the remedy is comparatively simple. If, on the other hand, poor distance reception is a characteristic of the locality where you live, you may be getting all that can be expected under your particular set of conditions.

Poor distance reception frequently is due to an inadequate antenna. Distance reception is always best on the highest and longest antenna you can put up. Of course, an extremely long antenna does not give the best selectivity, but if you must have distance the long antenna will help you get it. The mere fact that someone else is bringing in stations from Canada to Mexico on a thirty-foot antenna is no guarantee that you can do the same thing. The other fellow may be located where reception is particularly good. So the first step, if you are not satisfied with the number of stations you can bring in, is to see what can be done about improving your antenna.

Assuming that your batteries are all good and that there is nothing actually broken or disconnected about your re-

ceiver, the next step is to find out if the tubes you have in the radio-frequency and detector stages of your set are as good as they should be. Take them to your radio dealer and have them tested, if that is not possible, borrow a set of tubes from some neighbor long enough to determine if they improve results. The tubes in the audio stages of your set may be responsible for poor volume, but they have little to do with distance.

There is no way to predict in advance what kind of radio reception you are going to get if no receiver has been operated in your particular locality. That is why it is unfair to expect a radio set manufacturer to guarantee in advance that you will be able to get distant stations with any degree of certainty. All that any maker can do is to promise you that if it can be done, his set will do it.

OF COURSE there are sections of the country where reception is quite uniformly good over large areas. If you happen to live in such a section, your dealer can tell you in advance what stations are likely to be received best, but he can't be too definite even under these conditions. There always is a chance that some peculiarity of your particular locality may upset his predictions.

Experience has shown that it is possible to generalize on the possibilities of distance reception in certain sections. For instance, most of Westchester County in New York State is rather poor. Large areas in the middle west, notably in Ohio, Illinois and Indiana, are remarkably good. But even in good sections there are instances where distant stations are rarely heard, and in otherwise poor

sections isolated cases crop up of particular spots that are extremely good. The radio fan who happens to be located in one of these spots usually is credited with being the possessor of a marvelous radio set because he has no difficulty in bringing in stations enormous distances away. Actually, his set may be not one whit more sensitive than that of another listener near him who has trouble in receiving a powerful station only a hundred miles or so from his antenna.

No one, not even in a favorable locality, can expect to get consistent reception from stations thousands of miles away during the daylight hours. It can't be done with any type of set made. In fact, operators of the most powerful broadcasting stations in the country declare that they can be absolutely sure of reaching listeners at any hour of the day or night only when they are not more than one hundred miles away.

While you always can expect greater range at night than in the daytime, some nights are much better than others. Frequently there will be several nights in a row when you seem to be able to get any number of distant stations. Then there may come a period of a week or two when the air seems totally dead.

These changes in the strength with which distant stations are brought in give rise to remarkable effects. On one night you may note that stations from one direction are received with considerable intensity. The next night stations in the opposite direction occupy the center of the stage.

UNDER theoretically perfect conditions, stations are heard best when they are in the direction opposite the free end of your antenna. If you particularly desire to receive certain stations, try the effect of an antenna pointing away from these stations.

The uncertainty about distant radio reception has one redeeming feature—if the uncertainty didn't exist thousands of radio fans who now sit up all hours of the night trying to get distance would find that their hobby had lost one of its greatest fascinations!

New Ideas for Radio Fans

How to Get C-Current from B-Eliminator, Cut Out "Motorboating," Decide Correct Antenna Length, and Other Hints

THE popularity of the B-battery eliminator, coupled with the growing use of one of the power type tubes in the last audio amplifying stage of the radio set, has brought up the question of what to do about the C-battery. Power tubes require from nine to forty volts of C-battery. The current consumed in the C-circuit amounts to so little, however, that the life of a dry cell battery used on this current is just about as long as it would be if it stayed on the dealer's shelf.

You can solve the C-battery problem either by using a dry cell battery of the proper voltage and employing the B-battery eliminator for B-voltages only or you can, under certain conditions, obtain both B- and C-current from the B-eliminator. The separate battery on the C-circuit is the simplest and surest method.

If you want to get the C-voltage from your B-eliminator, try the circuit shown in Fig. 1. The heavy duty resistance shown in the diagram should be capable of carrying at least fifty milliamperes without serious overheating, and it should have a total resistance of about 2,000 ohms if you require a C-voltage of from twenty-seven to forty. The fixed condenser shown should have at least two mfd. capacity, lower values of capacity may cause some hum. With this current the C-voltage is, in effect, subtracted from the B-voltage available on the power loading post of the eliminator. Consequently the arrangement is practical only with the more powerful types of B-eliminators.

After you have hooked up the apparatus as shown, set the knob so that the resistance is all in use, snap on the radio set and B-eliminator, and then slowly turn the knob until volume and tone quality are best. Don't turn the knob any farther than necessary to get proper volume and quality, because if you cut the resistance down too far the C-voltage will be too low and the life of the power tube shortened materially.

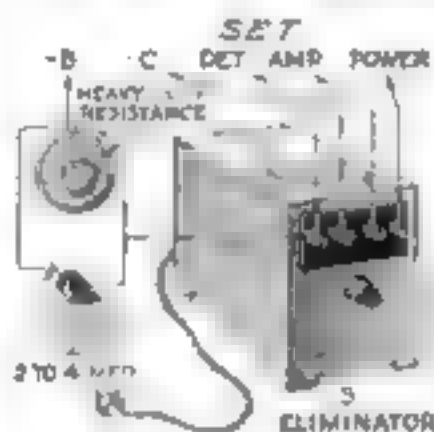


Fig. 1. How to get C-voltage from your B-eliminator by using a variable resistance and condenser.



Fig. 2. Use an asbestos shield on your soldering iron, as shown in the photo, when working in tight places to prevent burning the insulation from adjacent wires.

This apparatus will work on any type of power tube, the only difference being that on tubes that require relatively low C-voltages, you will have to turn the knob farther from the high resistance point.

Don't Burn Wiring

IN WIRING a radio set you are sure to run into places where it is almost impossible to get the soldering iron in contact with the wires you want to solder without pressing the hot body of the iron against the spaghetti tubing or other insulation on adjacent wires. Burning the insulation in this way can be avoided by constructing a simple shield (Fig. 2) consisting of a roll of sheet asbestos tied with wire that can be slipped on the

iron while you are working in tight corners. Do not leave the covering on the iron longer than necessary to make the difficult joint. If left on too long, the iron may burn out. Putting the cover on the iron when you first turn it on will help in heating it up.

How to Stop "Motorboating"

DIFFICULTY often is experienced in operating a set equipped with a resistance coupled type of audio amplifier by means of a standard B-battery eliminator. Either the quality is poor or there is that peculiar "put-put-put" effect nicknamed "motorboating." Increasing the condenser capacity of the B-eliminator, as shown in Fig. 7, sometimes effects a cure. Use condensers having a rated working voltage higher than the maximum developed by the eliminator. Adding capacity also will improve the quality.

If the motorboating persists even after the extra condensers are connected in the circuit, try reducing the value of the resistance of the grid leak on the power tube. This can be done simply enough even when the resistance coupled amplifier is of the enclosed type, by fitting an extra grid leak clip as shown in Fig. 4. Locate the grid terminal of the power tube. It always is the contact on the socket nearest to the contact pin on the base of the tube counting to the left. In other words, when you are looking down into the receiver the grid prong of the tube is just to the left of the pin on the side of the base.

A .03 megohm grid leak in the clip will be in parallel with the grid leak inside the unit, and you will not find it necessary to go lower than this value. The correct value for the extra grid leak is as high as possible while yet stopping the motorboating.

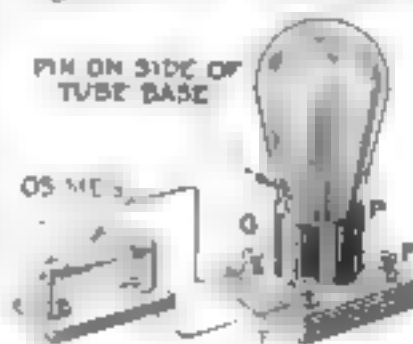


Fig. 4. Lowering the grid leak helps stop motorboating.

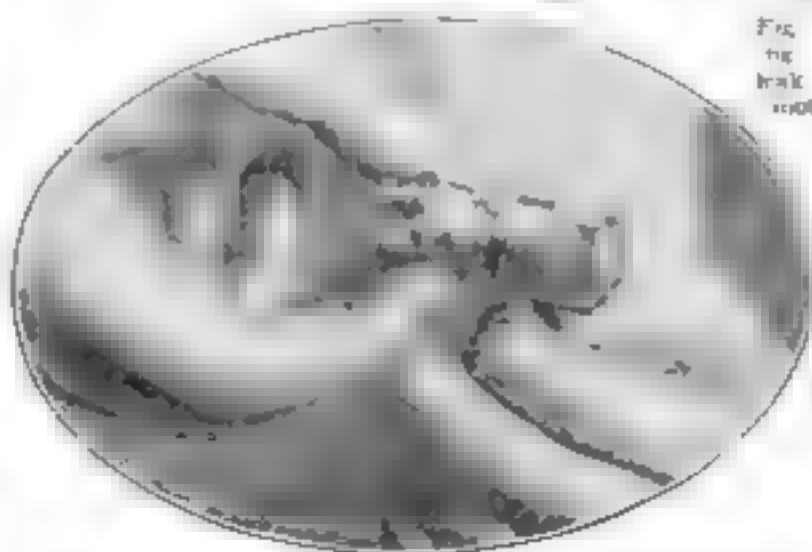


Fig. 3. This new style dial light includes the filament switch and can be added to your set without increasing the number of panel holes.

Light for Your Dials

MANY types of commercial receivers are now made with special arrangements for illuminating the dials. Special

als with lights built in are available to the home constructor of radio sets. In addition, there are several styles of panel lights that can be applied to sets already constructed to obtain the same effect. One of these is shown in Fig. 3. In this particular model the panel light also performs the function of the filament switch so that you can substitute it for the filament switch on the panel and thereby save drilling new holes. A knurled knob turns the light and the tubes in the set on and off in the usual way.

Wire Skinning Pliers

DURING the days when bare bus wire was most popular for wiring radio sets, any type of pliers was satisfactory. The fashion now is to use insulated wire. Consequently time must be spent scraping the insulation from the end of the wire at each joint or connection. You can save yourself this trouble by fixing your wire cutters so that they will serve to skin the wire. Take a sharp-edged oilstone, and stone a little groove in each cutting edge just deep enough so that when the jaws of the cutter are tightly closed they will not cut bare wire of the size you intend to use. To skin the end of a piece of wire,



Fig. 5. Adding a fixed condenser across the loudspeaker sometimes improves tone quality.

place the end at the notched point, close the pliers and pull. The insulation will be cleanly stripped off. You will find that there is room for several notches of different sizes to correspond with the various wire sizes you use without spoiling the pliers for ordinary use.

As shown in Fig. 5, the best location for these small notches is near the plier joint so that the ends of the cutting blades will be available for regular use whenever they are needed.

Try This to Improve Tone

SOMETIMES a worth while improvement in tone quality can be obtained by connecting a fixed condenser across the loudspeaker terminals as shown in Fig. 6. Capacity at this point in the radio circuit tends to reduce the strength of the audible tones at the upper end of the scale. In other words, a condenser across the loudspeaker terminals reduces hissing noises to a marked extent, shrill tinny musical notes are subdued, and the lower tones are not affected to any noticeable degree. If you prefer the deep-throated effect, you can get it by a condenser arranged in this way.

The value of the condenser depends on a

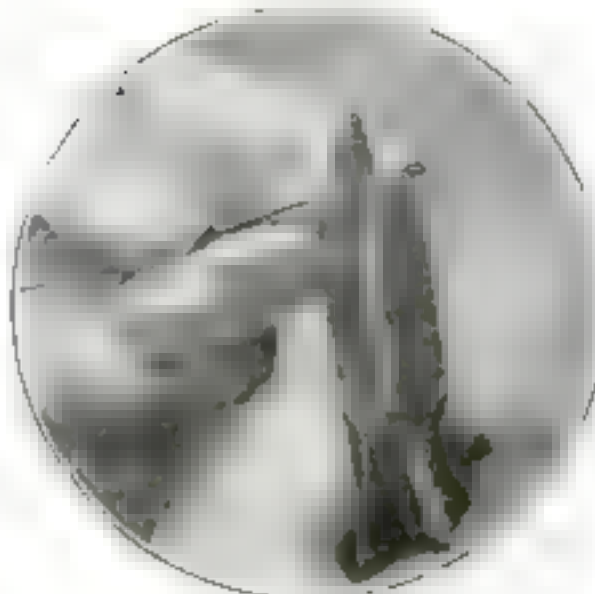


Fig. 6. Stripping the insulation from the ends of wires is quick and easy if you stone notches of the proper size in your wire cutting pliers.

number of factors, so that the best way is to try several until you strike one that works best according to your own ears. A condenser of .0005 mfd. is about as small as will accomplish anything at this point, and you cannot go beyond .01 without causing a considerable loss in volume. Small pieces of wire can be soldered to the lugs on the condenser and inserted in the plug with the loudspeaker cord tips.

Cutting Out Electrical Interference

THE question as to whether anything can be done about eliminating scratching and hissing noises produced by local electrical machinery depends upon the nature and location of the machinery causing the disturbance. The general impression is that reducing the length of the antenna or using a loop will im-



Fig. 7. Extra capacity added to eliminator stops motor boating.

prove matters, but this is not true in all instances. If, for instance, the interference is caused by machinery located in the same building with you, putting up a longer and higher outdoor antenna may effect a considerable improvement. In this case the ratio of signal strength to the strength of the interference is changed for the better. It is also a good idea to change the location of your antenna if that is possible. Interference produced by machinery outside your own building may be reduced by the use of a shorter antenna, especially if you can move the antenna farther away from the source of the noise.

Often, however, nothing at all can be done to improve matters. If you live near a trolley line and scratching noises are produced every time a trolley goes by, the only remedy is to move away.

To Increase Selectivity

ANOTHER use for small fixed condensers is to increase the selectivity if you find difficulty in separating stations on adjacent wave lengths. The simplest way to connect a condenser at this point is shown in Fig. 8, and this illustration as well as the one in Fig. 6 shows the correct way to hold a small fixed condenser while soldering a wire to one of the lugs. The condenser always should be grasped by the pliers on the metal part opposite the side where the lug is being soldered, as otherwise the metal of the pliers absorbs the heat from the metal of the condenser and prevents it from getting hot enough to take the solder.

In order to obtain any appreciable increase in selectivity with a series antenna condenser, very small capacities must be used. Try .00025 mfd. and then .0001. If the results still are not satisfactory, use two .0001 condensers in series.

The effect of a series condenser used in this way is somewhat the same as cutting down the length of the antenna. Consequently, soldering a condenser as shown is desirable only if you want to effect a permanent increase in selectivity as might be the case if the only available place for the antenna resulted in too long a stretch for best results in your particular locality.

A condition exactly the reverse of this, that is, where you are located far from the broadcasting stations and you can erect only a short antenna, requires different treatment. In this case selectivity is of less importance, while signal strength is what you are after. Fre-



Fig. 8. The selectivity of a long antenna can be increased by connecting a condenser in series.

quently a considerable increase in signal strength can be obtained by adding a coil of wire to the antenna circuit in place of the series condenser. The number of turns will depend on the length of the antenna you are using and also on local conditions which govern the natural wave length of the antenna. Try twenty-five turns of ordinary well wire bunched into a coil roughly three inches in diameter.

A Compact Radio Set



*Where neighbors are close
and space is limited, try this outfit*

By JOHN E. LODGE

The volume of protests from neighbors depends in inverse proportion on the kind of music inflicted on them. Excellent tone quality is possible from a small outfit.

"IF SOMEBODY doesn't murder that bird pretty quick, I'm going to do it myself," shouted the irate occupant of the third floor back. The rest of the boarders unanimously agreed that violence was called for—the swifter the better.

Meanwhile the cause of the impromptu indignation meeting was looking back in his armchair enjoying the hideous wails and thumpings of a fourth-rate jazz orchestra rumbling forth from an anti-crated tin horn type loudspeaker.

His situation was not unusual. Countless other dwellers in boarding houses and hotels, actual or potential radio fans, are faced with the same difficult problems in their search for adequate radio entertainment.

One of the most important is good tone quality. The volume of protests from neighbors depends in inverse ratio on the kind of music inflicted on them; the better the music, the fewer the kicks.

Lucky it is possible to obtain excellent tone quality from a reasonably small and compact outfit that will take up little space and be easy to move when the time comes for a shift to another residence. You don't want great volume anyhow because you are bound to have some neighbors across the hall who don't care for music of any degree of excellence. Besides, with low volume requirements you do not need the larger power tubes which call for extremely high B-battery voltages.

Everything considered, you will find that the 199 type tube has the most

favorable characteristics if size and portability of the receiver and incidental equipment are important. With 199 type tubes in all of the sockets of the set except the last in which you should use a 120 type dry cell power tube for the sake of quality, the receiver can be made small and the heavy, six volt storage battery needed to supply the filament current for the larger types of tubes is not necessary.

You can run a set fitted with several 199 tubes and one 120 tube on three ordinary No. 5 dry cells, such as are connected to the door bell, or if the places where you expect to live are supplied with electric light current, you can buy an A-power outfit consisting of a small light, two-cell, four-volt storage battery and a trickle charger.

FOR a B-battery you will need medium duty forty-five volt blocks of dry cells and one twenty-two-and-one-half volt block to use as a C-battery. Still further economy in supplying current to your set can be obtained by the use of several sets of three dry cells each connected in parallel to light the filaments, if you use the set an average of several hours a day a small, high grade B-battery eliminator will save space and money.

The size of the set and life of the dry cell A-batteries and B-batteries depend on the number of tubes in the set, consequently it is better to purchase or build a set with the fewest number of tubes consistent with the results you want to obtain.

Most of the standard types of radio

sets now on the market can be used with 199 type tubes. In fact, all modern radio sets are made with sockets of the UX type which will take the new types of either storage battery or dry cell tubes.

While the larger types of cone loudspeakers give remarkably perfect tone quality you may not have space for such an instrument and, besides, a large cone requires extreme care in handling. It would prove a nuisance to pack and move from one place to another. Horn type speakers are more rugged but have the disadvantage of poor tone quality, especially in the smaller sizes. One of the small size cones would appear to be the best selection. If it is absolutely necessary to keep the size of your equipment to the lowest possible minimum you can dispense with the loudspeaker entirely and use a phonograph loudspeaker unit fastened in a corner of the ceiling with the diaphragm toward the corner where the ceiling and two walls meet. Quite acceptable results can be obtained in this way both for volume and quality.

OF COURSE, if you do your receiving with a pair of headphones, a great saving is effected in the size, weight and cost of your whole radio equipment. In addition, you certainly will never annoy the most sensitive neighbor.

You will need some kind of antenna unless you purchase an expensive, loop-operated set. If you cannot get permission to put up a temporary outdoor antenna, string a piece of bell wire around the picture molding in your room.

Sam Loyd's New Puzzles

How Fast Can You Think?

Seven Brain-Teasers to Check Your Abilities



Have You Imagination?

"A hundred and fifty when joined to a tree
Makes a fine garment to warm you or me."

That couplet fits the picture above and poses a riddle. What cozy-sounding garment is suggested by the sketch?

Rebuses and riddles are a test of your wit and imagination. Try to solve this as quickly as possible, then turn to page 139 for your rating.

Can You Analyze Facts?

FOUR little girls and their four brothers divided thirty-two apples among themselves as follows: Ann got one apple, May two, Jane three, and Kate four. The boys' mounds were more complicated. Ned Smith received as many as his sister, Tom Brown twice as many as his sister, Del Jones three times as many as his sister, and Jack Robinson four times as many as his sister.

From these facts, can you figure out what must have been the situations of Ann, May, Jane and Kate? Aside from the elementary mathematics involved, the problem calls for ability to pursue analysis beyond orthodox formulas. The solution is found on page 139.



Are You Quick at Figures?

"THE call for a standing vote, Mr. Chairman," reported the secretary at the Rotary Club meeting, "showed that the motion was carried by a plurality equal to one third of the opposition. But as that result, it develops, was due to a lack of chairs, preventing eleven members from sitting down to register

their votes in the negative, we wish to report that the apparent minority actually defeats the motion by one vote."

From the secretary's report, can you tell how many votes were cast, pro and con, and prove your quickness at figures. Find your rating on page 139.



One for Mental Bookkeepers

TWO sisters have found it an agreeable plan to pool their allowances and do their shopping together. On one of their recent visits to the stores, Martha bought a hat and a pair of shoes for \$15. Then Gertrude paid as much for a blouse as Martha did for her hat, and invested the remainder of their money in a parasol for herself.

On the homeward trip, Gertrude, who had been "thinking over" a remark of Martha's about her blouse's costing as much as Martha's hat, called attention to the fact that Martha's shoes had cost \$1 more than Gertrude's parasol. "That's true," agreed Martha, "and if we had apportioned the blouse and shoe money so as to make your blouse cost half as much again as my shoes, then our total expenditures would have been equal, 'fifty-fifty,' as the boys say."

From the facts given, if you have an aptitude for analytical bookkeeping, you should be able to give the respective costs of the four purchases in a few minutes. Time yourself, then turn to page 139.

SAM LOYD, the world's most famous puzzle man, offers these brain-teasers from month to month in POPULAR SCIENCE MONTHLY in response to requests from hundreds of readers. To use them as real tests of your mental ability, time yourself in solving them and compare your time with the ratings on page 139.



Are You Observing?

IN THIS seesaw, the balance point is exactly in the center of the beam, and the elves are teetering in exact balance. Now, if all the boys in the two groups were seated on one arm of the seesaw, how many girls would it require on the other side to effect a perfect balance? Of course it must be assumed that boys weigh alike and girls weigh alike.

Your speed at solving this will test your aptness at grasping and resolving visible evidence. Turn to page 139 for your rating.

A Test of Vocabulary

WHEN a puzzler "beheads" a word, he removes the first letter. Here, then, is a test of your vocabulary and quickness in visualizing words. Behead:

A word meaning to desire and leave one meaning to act irrationally; a wooden case and leave a price; a tale and leave efficient; a measure and leave indisposed; a limb's extremity and leave a conjunction; an injury and leave a limb; a culinary concoction and leave a residue; part of a boat and leave a marine creature; a woundred and leave the middle of a clutch.

Time yourself, then turn to page 139.



Have You Keen Sense of Form?

ABOVE is a design suggested for the battle flag of the Zulu Navy. From a puzzler's standpoint, the advantage of the design rests in the fact that when the Zulu ship is ready to surrender and send the symbol of defeat to the maintop, a square white flag can be nicely constructed from only two pieces cut from the white parts of the battle flag.

Discard the rectangular dark central section. Then divide the remaining white part into halves, of exactly the same shape, which will fit together to produce the white square.

This is a rather difficult test of your sense of form and proportion. Time yourself, then refer to page 139.



A picture house like this, even
remodeling, you can construct
in about 100 days many turn
out well in the town. N. Y.
and you at a cost of \$16,800

What It Costs to Build

*Facts and Figures about Materials and Labor That
Will Help When You Plan to Construct Your House*

By

JOHN R. McMAHON

MY TAILOR is building a house. The other day he asked what I would think of him if, when I asked when a suit would be ready and what it would cost, he replied: "Maybe in a few weeks, maybe some time next fall. I never promise any time. Don't know the cost exactly, fifty or seventy-five dollars, perhaps. It might even turn out to be a hundred dollars."

I told him I'd think him crazy.

"I am having a house built," he said with a grin, "and I'm just trying out on you the line of talk the building people give me. I can tell customers that but tons, lining and wages may go up or down but I couldn't promise a delivery date because unexpected conditions might arise. But I don't. Why isn't a house like a suit of clothes?"

Rightly or not many persons share the critical sentiments of my tailor in regard to home building. "What will it cost?" is something of a popular riddle and there are many obvious reasons. Houses differ greatly in themselves and in the conditions under which they are built. Most of them are individual hand jobs. Their materials are retailed at all sorts of prices and wages vary widely between Mohrle, Boston and Seattle.

But there are two common methods of estimating house cost. One is based on surface area, or square feet, the other on volume, or cubic feet. Both are rough but useful.

In estimating by the volume method, you multiply length, width and total height of building from cellar floor to roof. Add roof contents in cubic feet for an ordinary peak, the roof contents would be half the roof height at ridge multiplied by length and width. Dormers can be treated as small peaks figured separately. Finally multiply the total volume by the cost per cubic foot of that type of dwelling.

SOME idea of the cost per cubic foot of different types of dwellings may be had from the following figures, covering an eastern metropolitan area last year (they do not include contractor's profit, which may amount to ten percent more). Bungalow of three or four rooms without basement, 32 cents per cubic foot; frame dwellings built by a speculator, 40 cents; a stucco residence, 48 cents; brick house

termed semireproof, 44 cents; rather high class masonry dwelling, 49 cents. It may be interesting to compare with these figures, 28 cents for a garage, 54 cents for an apartment house, 63 cents for an office building and 91 cents for a first-class hotel.

IN ESTIMATING the house cost by the area method, outside walls are considered. Using this method, one expert offers 61 cents as the square foot cost (minus contractor's profit) of an outside wall in wood frame, with sheathing, paper, siding, lath and plaster inside and three coats of paint outside. A similar wall with shingles instead of siding costs two cents a square foot more. If the outside covering of the wood frame wall is stucco on metal lath, the price jumps to 86 cents a square foot. Some of the extra expense is due to the high grade water proof paper under stucco, also furring labor and material. Frame with face brick veneer amounts to 97 cents, while a solid eight-inch wall of common brick, furred and plastered inside, is only 86 cents. Hollow tile, eight inches thick, stucco outside and plastered directly inside, is 93 cents. Concrete block costs something less than hollow tile. While

the figures show a large difference as to outside wall costs, it is asserted that, in relation to total building cost, masonry is only six or eight percent more expensive than wood frame.

L. H. OLSON, vice president of the American Appraisal Company, tells me that his concern uses neither the ordinary volume nor area method described, but bases its cost estimates on wall perimeter and living floor space. Wall perimeter means simply circuit measure. Living floor space excludes all nonliving space, such as the attic, basement or elsewhere. All bathrooms, recreation rooms and finished rooms in general belong within the definition. On this basis, Mr. Olson estimates the cost of a present-day house at \$5 to \$8 for each square foot of living floor space. Thus a house 30 by 33 feet, inside measure, two floors usable, would cost \$10,500 at the lower rate and \$16,800 at the higher figure, which calls for more expensive material and workmanship.

These figures check up fairly well with others based on building area. The actual cost of a first-class dwelling was found to be \$13.00 per square foot of building area, the detail costs per square foot of building area being as follows:

Excavation	80 23
Masonry	2 10
Rough framing (wood, metal lath and stucco)	4 23
Interior finish	3 00
Plumbing (brass pipe for water supply)	1 90
Heating (hot water, coal furnace)	1 00
Electric lighting, with fixtures	83

Total per sq. ft. building area \$13 00

Cutting in two the interior finish item, which in this house included rare and luxurious details, the house belongs in the class previously described as worth \$8 per square foot of livable area.

A NUMBER of so-called model houses were built last year in various parts of the country by the cooperative action of newspapers, trade interests and various architectural institutions. One of these was constructed at Buffalo, N. Y., having six rooms, the materials being brick, half timber, stucco and siding. Its cost was distributed thus:

Excavation and foundation, including garage and cellar floor	\$1,510 00
Carpentry and millwork (California white pine for exterior and inside trim, fiber board insulation—hardwood floors)	3,737 43
Plaster, three coats on fiber insulating lumber	923 30
Brickwork and stucco outside, three coats open fireplace, masonry with chimney	2,011 10
Tiling, bathrooms, hearth	213 30
Plumbing, brass pipe for water supply, automatic gas heater for hot water	1,028 68

How to Figure the Cost of a House on a Basis of Its Cu. Ft. Capacity

FIND total cubic foot capacity; multiply this by the accepted cost per cubic foot for your locality. For example, taking the above house:

House below attic	28x30x21 = 21,192 cu. ft.
Roof	28x30x4 1/2 height = 4,052 cu. ft.
Total capacity	25,244 cu. ft.
Total cost in frame	25,244 x \$.40 = \$11,297 60
" " " stucco	" " .43 = 12,156 32
" " " brick	" " .44 = 12,448 36

(These cost-per-cubic foot figures, 40, 43 and 44 cents, are accepted costs in an eastern metropolitan area.)

Heating, steam, oil burner	\$1,000 25
Roofing, asphalt shingles	
copper flashing, gutters and leaders	335 50
Electrical work	685 10
Windows, steel frame; plate glass; weather stripping	780 91
Hardware, locks, etc.	233 02
Painting and decorating, including linoleum	1,080 14
Kitchen equipment, gas range	230 00
Window shades and screens	81 25
Total labor and materials	\$16,004 11

COST OF BUILDING, 1913



With building materials and labor doubled and even tripled since 1913 a house built today costs at least twice as much as the same house built before the war.

These figures do not include the architect's fee, contractor's profit and various sundries. It may be noticed that little was spent on the roof compared with the heating plant. Other items, also, might be adjusted to personal preference.

IN INTERESTING contrast with the Buffalo house is another six-room house erected under like auspices in a suburb near New York City. Though specifications for both houses were about the same, labor and materials for the second house cost \$2,000 more. Excavation and foundation were \$150 less than for the Buffalo house; carpentry and millwork costs were almost identical; while plastering cost \$115 more on the Atlantic seaboard than on the shores of Lake Erie. Such a substantial difference

must be attributed to the wage factor. Brickwork and stucco outside were \$60 higher at the seaboard location. Extra tiling in the latter case—in bathrooms up to the ceiling and in kitchen up to a height of four and one half feet—accounted for \$900 more on this item. Plumbing was \$333 higher on the coast.

Heating with oil burner was \$534 more expensive, but this difference can be explained by the installation of a hot water system instead of steam. Roofing of the same sort was about \$100 less in the eastern district, and this difference was almost precisely reversed on the item of electrical work. Windows of steel frame were \$63 higher on the seaboard.

Hardware was \$132 cheaper on the first dwelling, but this item has a wide variance anywhere on account of quality. Painting and decorating were \$184 less in the metropolitan area.

THE last item, window shades and screens, seems to reveal a startling extra charge of more than \$900 for the suburbs of New York. However, the specification of bronze wire screening in the latter case goes a long way toward explaining the cost. It would still appear that with an allowance of \$2 per shade, the screen doors and window screens of this house would cost between \$8 and \$10 apiece.

Knowing the price of materials and the rate of wages, the big question remains, how much can the worker accomplish per hour or day? Quality counts in building a house, and a too hurried job is bound to be poor. Nevertheless an approximate estimate of what one able-bodied man can accomplish in one day under average conditions is helpful, and is offered as follows:

Excavation, pick and shovel	125 cu. ft.
Rubberfield stone masonry	40 cu. ft.
Concrete, hand mixed and placed	34 cu. ft.
Cellar floor, concrete	10 sq. yds.
Cutting blue- or limestone	7 sq. ft.
Bricks, common, 8-in. wall, with header	850 bricks or 56 sq. ft.
Face brick	425 " " 28 " "
Concrete block	(continued on page 137)

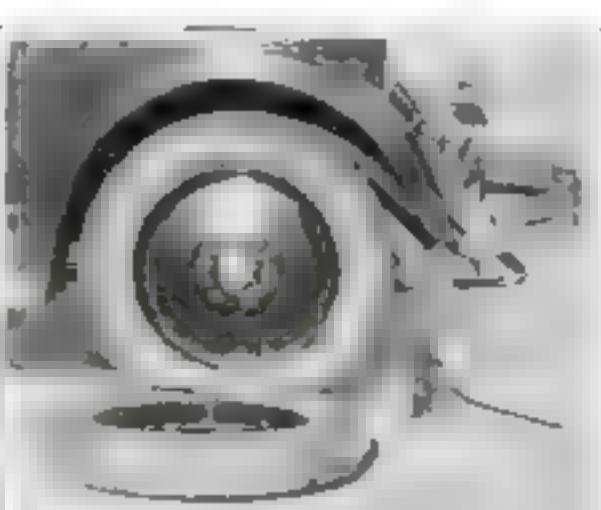
INCREASED
COST
OF
BUILDING
1927

Useful Ideas for Your Car

Air Moistener, Battery Handle, and Other Ingenious Kinks

UNLESS you are equipped with a special jack designed now enough so that it can be placed under the axle when a balloon tire goes flat, you may find it extremely difficult to change tires. If you get stuck this way, your spare tire may solve the problem. Simply place it in front of the flat tire as shown in Fig. 1 drive the car ahead till the flat tire rolls on to the spare, and then slip the jack under the rear axle. Working the jack lever takes the weight off the spare tire so that it can be exchanged for the flat one.

Fig. 1 Using the spare tire to help get the car on the jack if you have difficulty getting the jack under the rear axle



Turnbuckle Compresses Rim

IF YOUR car is fitted with rims on which the lugs are part of the rim, a good sized turnbuckle can be used to compress the rim and allow you to take off a tire even if it is badly rusted. While it is better to use a large turnbuckle, a small one will do if you piece out from the turnbuckle eyes to the lugs by means of hooks of the proper length. Fig. 3 shows how the turnbuckle is used.

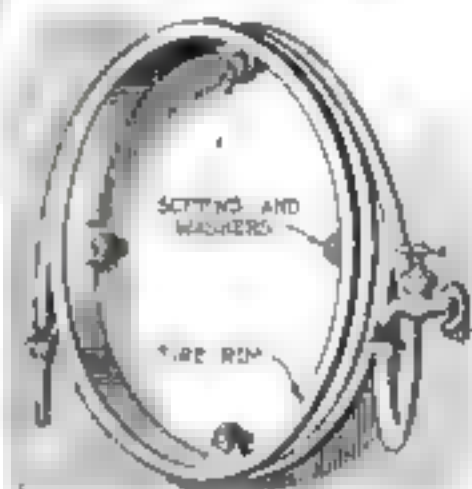


Fig. 3. The hose you use for washing the car can be kept out of the way and where it is handy with a reel made of an old automobile rim as shown above

To Close Platen Rings

IF YOU find it necessary to fit new stiff rings and you have no ring compressor, a string arranged as shown in Fig. 6 will permit you to do the job without trouble. Tie the end of the string to any convenient bolt, pass it around the ring and pull on the handle.

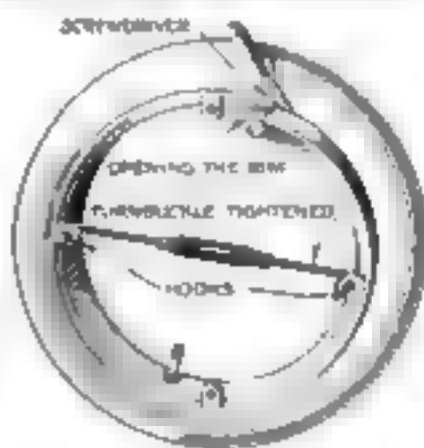


Fig. 5. A turnbuckle used as shown here will enable you to remove a tire easily, even though it is badly rusted on to the rim

Air Moistener

ONE of the objections to the ordinary way of building a moistener for the air that goes into the manifold of your motor is that there is a chance, when the car goes over a bump, of the water's splashing up and being drawn into the manifold in the liquid state. By building your air moistener in two mason jars as shown in Fig. 7, the second jar acts as a water trap. In operation, the suction of the manifold causes a constant stream of air to flow from the nozzle in the first jar and come up through the water in the form of fine bubbles. The amount of water vapor absorbed by the air is in proportion to the size of the bubbles; the smaller the bubbles, the more nearly the air drawn through the jar approaches the saturated state.

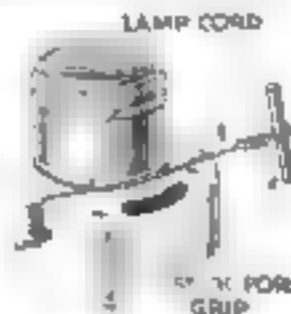


Fig. 7. Ingenious arrangement of two mason jars to serve as an air moistener. The second jar prevents any of the water from being drawn into the cylinders

Saving Your Springs

WHILE the best possible insurance against spring breakage is a set of properly adjusted recoil snubbers, you will find that fabric belts clamped around the axle and the frame as shown in Fig. 4 are worth while. The belts will not interfere with the free action of the spring when a bump is encountered, but when the car starts to bounce too high, they will prevent bending the springs the wrong way so far that they break. If your car has a tendency to excessive up and down wobble when you hit a succession of bumps, special clamps, like spring clips, fitted with leather friction pads, can be used to increase the friction between the leaves and in this manner deaden the spring action.

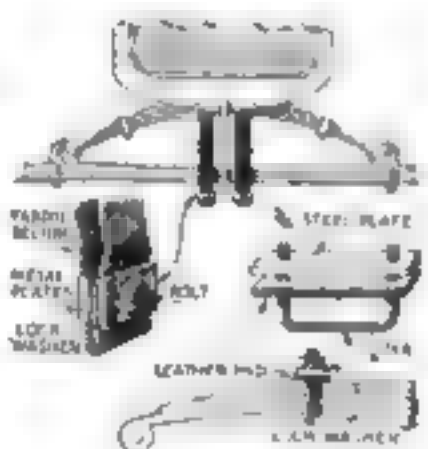


Fig. 2. Fabric straps as shown above will prevent excessive rebound and keep your springs from breaking. Special C-clamps stop the bouncing

Old Rim As Hose Rack

THE short piece of hose that you keep in the garage to wash the car can be kept in good condition, handy and yet out of the way, by bolting an old rim to the wall near the water tap as shown in Fig. 3. Almost any old rim will provide ample space for the short piece of hose that is ordinarily used in the home garage.

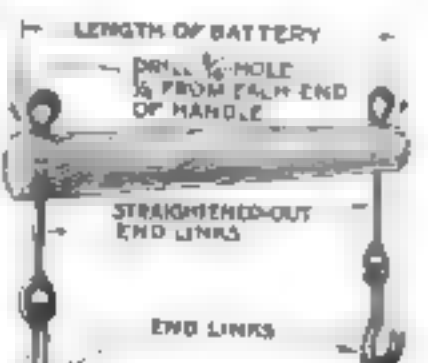
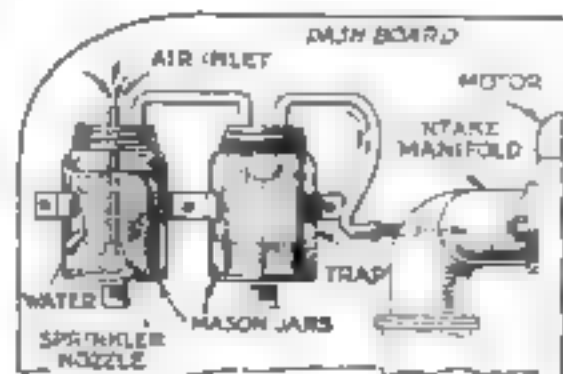


Fig. 4. An old shovel handle and some end links from an old skid chain can be made into the storage battery handle shown above

Fig. 6. Right: An emergency way of closing up rings to get the pistons in to the cylinders

Simple Battery Handle

FIGURE 4 shows you how to make a simple handle that will fit almost any storage battery. It is made from a stout piece of wood, such as an old shovel handle or fork handle, and the end links are from an old cross chain. After the holes are drilled at each end, two links are straightened out and passed through the holes.



M. L. BURGHAM, of Paramus, N. Y., wins the \$10 prize this month for his suggestion of an air moistener (Fig. 7). Each month POPULAR SCIENCE MONTHLY awards \$10 in addition to regular space rates to the reader sending in the best idea for motorists. Other published contributions will be paid for at usual rates.

How to Save Money on Tires



"LOOK at the way he's trying to figure how much air he's getting!" said Joe. "Some day he'll blow!" A report like a fire-cracker explosion interrupted him.

Under-Inflation and Neglect Cost You Miles and Dollars

By MARTIN BUNN

OLD BURR sure has a permanent cramp in his pocket-book," grinned Joe Clark to his partner, Gus Wilson, as the departing customer let in the clutch and drove away from the Model Garage. "He's penny-wise and pound-foolish," observed Gus. "Our prices on tires are reasonable and we don't palm off stale stock. Just wait till he gets stuck good and plenty on a 'gyp' tire, then we'll have him for a regular customer."

About a week later Burr pulled up in front of the Model Garage near the air pump and proceeded to apply the hose to his tires. There was a new shoe on his right front wheel. Gus noted.

"I've tried to sell him a tire pressure gage," said Joe. "The old tightwad won't buy one. Just look at the way he's trying to figure how much air he's getting!" Kicking the tires won't tell him anything. Someday he'll blow."

A report like a fire-cracker explosion interrupted him. Burr in an instant was enveloped in a cloud of dusty tire tale.

"By Jinks, he's gone and done it!" The two men rushed over to Burr, who was vainly trying to dig the dust out of his eyes. Apparently the tire had torn loose from the rim and the blow-out had ripped a five-inch piece out of the tube. Both the new shoe and the tube were completely ruined.

"I'll have the law on 'em for selling me a dangerous article!" blustered Burr when he had recovered from his amazement. "They guaranteed that tire, and I'll see that they make good!"

"If you do," soothed Gus, "it will be the first time I ever heard of a gyp making good on anything. Besides, you can't prove you didn't blow it up too hard, working without a gage."

"But I can tell by kicking when

they're getting enough air," protested the angry motorist. "I never had any trouble like this before."

Your car must be a lot more sensitive than mine, then," growled Gus. He bent over to inspect the wrecked shoe. "This sure is a gyp business for fair. Hardly any wires in the head—no wonder it stretched over the edge of the rim. And look how thin the rubber is."

"Humph!" snapped Burr. "And how do you account for the fact that I got five mileage out of the last shoe I bought from that same dealer?"

"Good luck—bad call," Gus answered. "You might have as good luck again if you buy more of his junk tires. But you can take it from me, when a man sells

you a tire at half the regular price, it isn't worth even that."

"The worst of it is that it takes an expert to tell what's the matter with a cheap tire. It may look all right, but how do you know that it isn't over-cured? Or maybe there's a break in the run, fabric under the rubber."

IT'S all right to talk about "factory bleached" tires and how there's nothing the matter with them except possibly an "irregularity in the tread" or that they "don't look just right," but you can bet your boots the factory inspectors aren't going to throw out a tire just because there's a couple of fly specks on it. The inspectors are paid for knowing how to find real defects that will shorten the life of the tire, and when they say it's not up to snuff you can take it they're right.

Of course this tire wasn't even a good factory "second." It's just a junk tire made to sell at any price and still give the dealer a big profit.

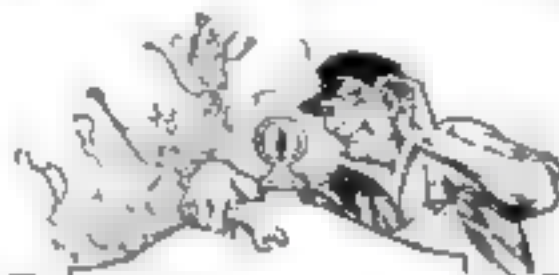
Perhaps you're right," admitted Burr, half convinced in spite of himself.

How much did you say you'd charge me for a new shoe with a lot of discount for cash?"

"I'd throw in a really good tire gage as discount," grinned Joe. "It'll save you more dollars than any cash discount."

"I'll take it," agreed Burr. "It seems like a lot of money to be spending on one tire, though."

Not when you figure it out on a dollars per mile basis. That's all you're getting out of any tire—so many miles of running at so many cents a mile, and if you can get twice as many miles out of a tire that costs only a quarter or a third more, you're making a big saving. If some manufacturer could make tires that would give fifty thousand miles instead of the ten or



What Was Wrong with Markin's Car?

IN THE February issue POPULAR SCIENCE MONTHLY published a story detailing Markin's troubles with his new car, offering a prize of \$25 for the best letter explaining the trouble and telling how to overcome it.

Julius C. Lapp, of Orano, Maine, wins the prize. The contributor was short-circuited, and many contestants indicated this as the source of trouble. Of these, Mr. Lapp, in the opinion of the judges, offered the most accurate diagnosis of the trouble and the simplest and most effective remedy.

fifteen you get now, they'd certainly be bargains at a hundred dollars apiece.

"There are other ways you can save money on tires, too," Gus added as he started mounting the new shoe on the rim. "Taking care of them is the best way I know of. First and most important, keep 'em pumped up to the right pressure all the time. Joe'll give you a chart that shows the right pressure. Keep the pressure two or three pounds more than the low limits shown in the table. Also, you want to remember that the weight the tires carry is what determines the amount of air you want in 'em. If you go on a long trip alone, you can get easiest riding qualities by having the air pressure down pretty near the low limit."

"ON THE other hand, if you start out with four or five big, lanky chaps in the car besides yourself, and a lot of luggage for good measure, remember to pump the tires hard enough to take care of the extra weight. Three heavy men on the back seat and a trunk strapped on behind may add as much as three hundred pounds apiece to the load on each rear tire, and if the pressure is down to the minimum figured for the weight of the car alone, the extra weight will squish out the tires and the side walls will get too much bending. That means destructive friction in the cord fabric in the side walls of the tire, and if you happen to run over a car track or a brick, you are almost sure to get what is known as a rim bruise. The tire may look all right for quite a while afterward, and then there'll be a mysterious blow out."

"That explains what must have happened to a shoe that blew out last year," said Burr. "It looked like a defect to me, but now that I think of it, there was a slight dent in the rim at that point."

"Sometimes you can dent a rim without damaging the tire," explained Gus, "but a dent in a rim is a bad sign. If you have tried to pound a dent out of a rim, you know how tough the steel is. It takes a thumping hard blow to put a dent in one. That blow is transmitted to the rim through the walls of the tire."

"Then if I keep my tires pumped to the right pressure, my troubles will be over?" questioned Burr.

"MOST of them will be, but other little things can cause a lot of grief. A piece of glass in the road may make a cut in the rubber tread that looks too trifling to bother with. Water gets into the cord fabric through the hole and rots the cords. After a while the tire blows out at that point; or maybe sand works under the tread, raises a blister and eventually ruins a part of the tread."

"Watch out that your tire chains aren't too tight, too. If you don't have them loose enough so that they can creep around the tire, they will cut right into the rubber."

"I don't use chains much anyway," said Burr, "so that doesn't bother me. But what am I supposed to do about those little cuts and things?"

"The safest way is to go over your tires once a week," Gus advised. "If you find small cuts in the tread, fill up the hole with tire dough, if a piece of the tread has been torn away, have it vulcanized before it gets any worse."

"How many miles have you driven this

"I can tell that by looking at it," Gus laughed, "but I have a hunch that the wheels are out of line. The tread seems to have a rubbed appearance caused by the sideways slip that always happens when the wheels aren't in line. Have you bumped into anything lately?"

"CERTAINLY not," replied Burr. "That is, I haven't hit anything. About two weeks ago, though, I got into a jam and had to drive up over a high curbstone to save smashing into a car. It jarr'd the car quite a bit."

"That's what's the matter, then," said Gus. "You must have hit the curb at an angle and the sudden strain bent one of the steering knuckles a trifle. I'll line up the wheels for you right away. You want to watch out that the front wheels don't get any sideways bumps like that. Even running the front wheel against the curb when you're parking the car will sometimes spoil the alignment. Driving fast in deep ruts is bad, too. Wheels that are out of line as much as a quarter or a half inch will grind off the tread in no time."

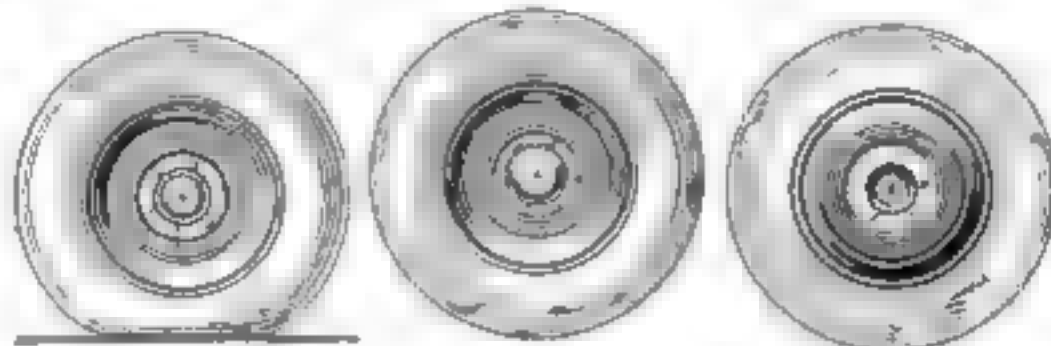
"I should think that if the front wheels were out of alignment you would notice it in the steering," observed Burr.

"Not necessarily," Gus replied. "A slight error throws both wheels out a trifle, and the strain is divided between them. Besides that, the steering wheels on modern cars are geared so low to make easy steering with balloon tires that a slight drag would hardly be noticed. The only safe way is to have them checked up occasionally, especially when the front shoes seem to be wearing more than they ought to."

"Here's another point that lots of drivers don't realize. Extra wear is put on the tires if one of the wheels wobbles because the axle is bent or because the rim isn't on straight. This accounts for many queer cases where the tread seems to wear away much more at two points on opposite sides of the tire, remaining unworn at the sections between. You see, each time the wheel turns, a part of the tire moves sideways as well as straight ahead, and that means extra friction."

"Well!" said Burr. "My neighbor's tires never seem to wear out, and now I think I know why! I notice he's always testing the pressure or looking them over. I thought that was all foolishness and a waste of time, but there may be something in it after all."

"Two things," Gus stated. "First, you save money because your tires actually give you more miles. Second, if you know just how you stand on the tire question, you're not likely to get stuck with a flat tire so often."



Under inflation causes excessive tread wear

Cuts in tires should be repaired at once

Sand works under the tread, causing blisters

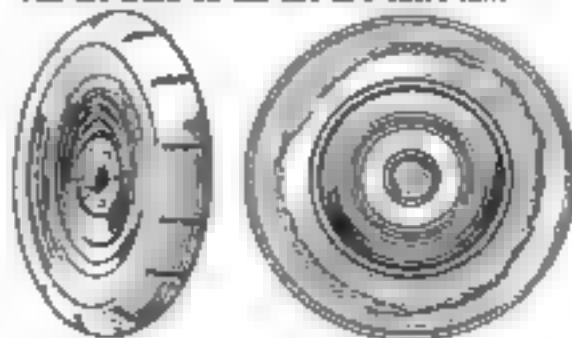
Use This Table When You Inflate Your Straight Side Balloon Tires

Minimum Inflation Pressure (Lbs.)	Maximum Load Carrying Capacities Per Wheel (Car and Passengers)								
	4.40	4.75	4.95	5.25	5.77	6.00	6.20	6.75	7.30
22	500	580		700		850	900		1150
24	550	635		760		925	980	1100	1260
26	600	690	725	820	880	1000	1060	1200	1370
28	650	745	780	880	950	1075	1140	1300	1480
30	700	800	835	940	1020	1150	1220	1400	1590
32	750	855	890	1000	1090	1225	1300	1500	1700
34	800	910	945	1060	1160	1300	1380	1600	1810
36	850		1000	1120	1230	1375	1460	1700	1920
38			1055		1300	1450		1800	
40			1100		1370			1900	
42					1440				

Underlining denotes maximum desirable load



Wheels that are even slightly out of line rub the tread off the tire in a short time



Cuts such as these are caused by tight chains

Scraping against curbs does this to your tires

other front tire?" Gus inquired, bending over to inspect the tread.

"What's the matter with it?" countered Burr suspiciously. "It's nearly new. I put it on about a month ago."



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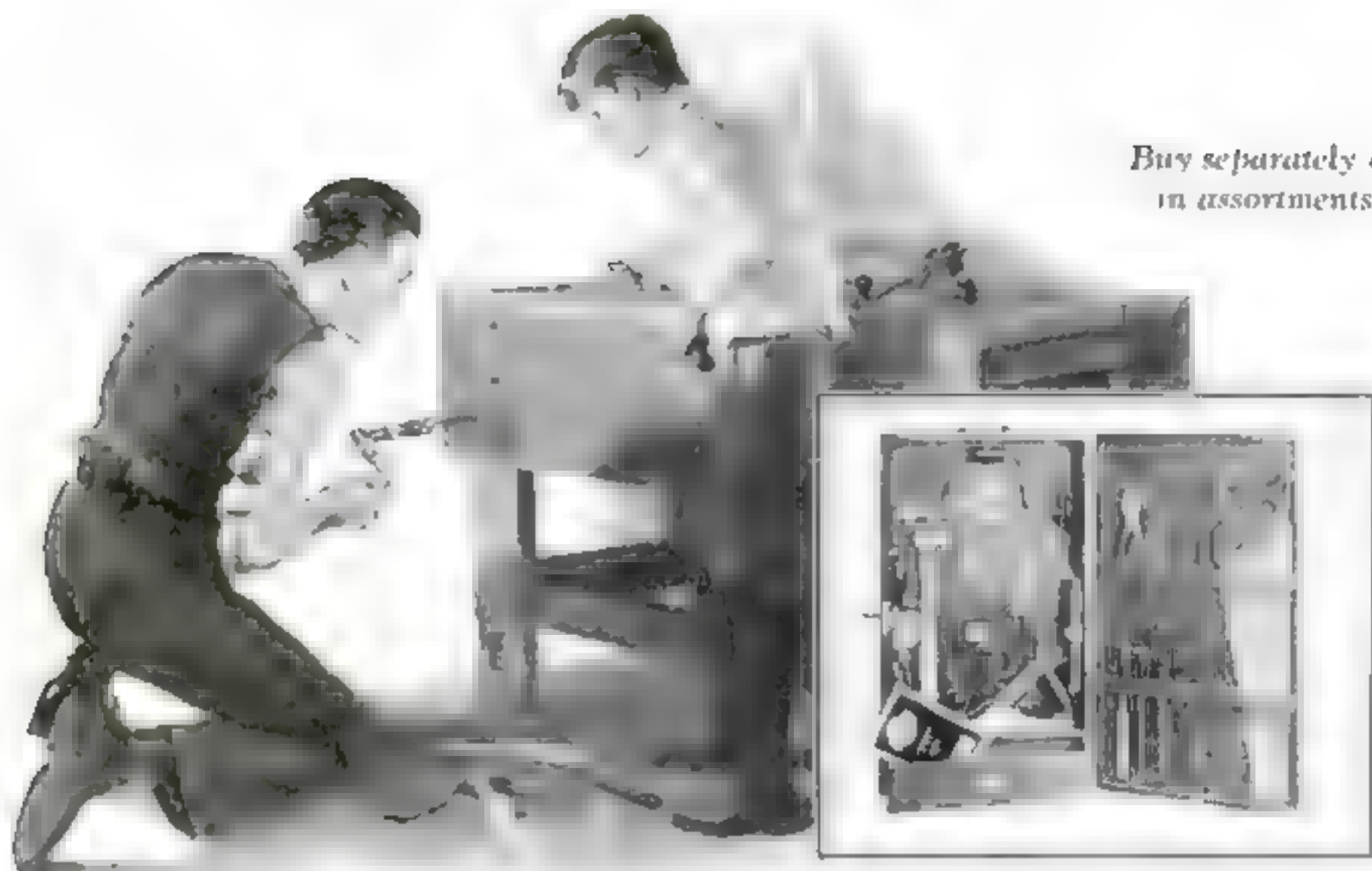
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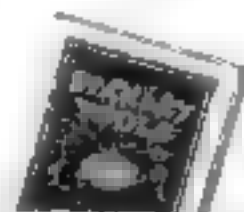
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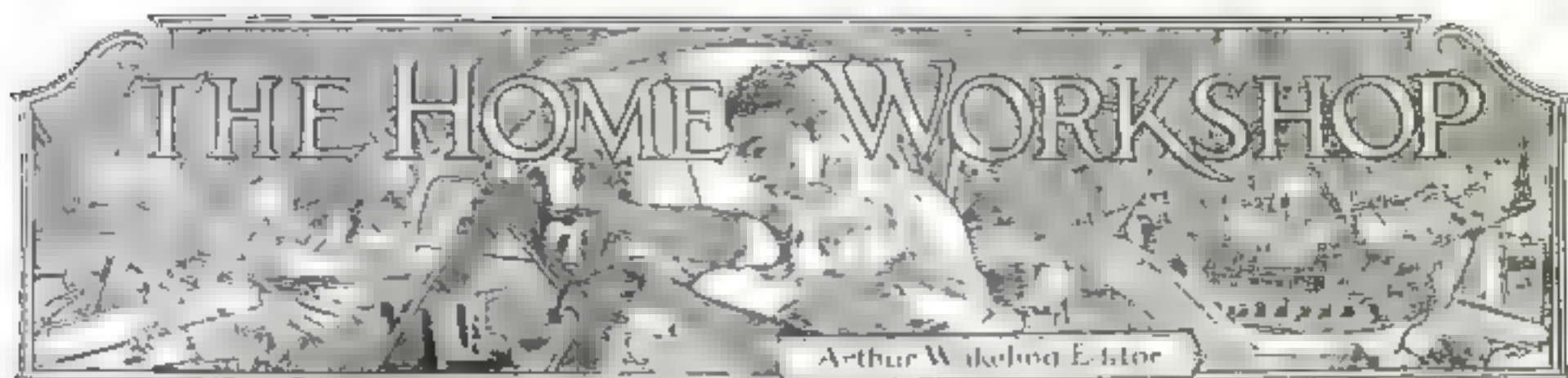


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STANLEY TOOLS



The joys of camping are doubled when a roomy and comfortable canvas house is built in place of an ordinary tent.

How to Build a Canvas Camp

Semiportable Summer House Offers Many Comforts Has Substantial Floor and Frame

By HENRY S. LARABY

CAMPERS who have picked a pleasant location to which they return year after year—and their number becomes larger each season—will find many advantages in constructing a semiportable canvas house of the type illustrated above.

The sides, top and ends can be transported easily by car. The platform and framework are built on the spot and left in place permanently.

One of the strong points of this arrangement is the doing away with the usual pegs for holding the tent top and fly. Every tent camper can remember the stormy nights when all hands have had to turn out in the midst of a violent downpour to drive down slipping tent pegs and adjust the shrunken guy ropes. In place of pegs, there are separate guy rails, each 2 by 2 in. by 13 ft., for the top of the tent and the fly. These are supported by 2 by 4 in. posts, heavily braced.

The method of building the platform and framework is made clear in the drawing at the bottom of page 106.

To set up a camp of this kind, first build the platform and frame and then use a steel tape to take the over-all measurements of each section that is to be covered with canvas. Make sketches and put on the dimensions as you go along. This done, give the woodwork two coats of good outside oil paint.

The canvas sections can be ordered from a tent or awning concern, or one can sew them at home. In either case select a good grade of 12-ounce canvas.

If you decide to make the sections yourself, find a floor or other cleared surface large enough to lay out the largest of them. Measure off a section and drive a 1½-in. nail at each corner. Go 3 in. outside of these dimensions, and

drive other nails at the corners. Around the outside nails stretch a cord tightly. Lay the canvas in strips across the section in the proper direction, lapping them 1 in. over each other and pinning at intervals of 2 ft. When you have laid and pinned a strip, cut the canvas off where it passes the cord. Keep laying and pinning the strips until the surface is covered, trim off the ends of the combined strips so that the edges are straight, and then move the cord back to the nails that mark the finished size of the section. Fold the edges of the section over twice, that is, make two 1-in. folds (see page 106). Pin the edge as you go along.

Corner pieces can now be inserted, if desired, lay them under the folded edges and pin in place. Fold up the pinned section when completed and lay out the next.

When all are done, sew them up with the heaviest thread the machine will handle. Windows (Continued on page 106)

A Table for Your Bench Lathe

How to Make a Neat and Convenient Stand for Small Machine Tools—Reduces Noise and Vibration

By COLIN L. BLAIR

WHEN the writer purchased a small screw cutting bench lathe, he was confronted with the problem of constructing a satisfactory table arranged for its motor drive.

The usual method of driving small lathes seems to involve the use of an overhead countershaft, and this was not desired. As the outfit was intended to be used in a city apartment, compactness and neat appearance were essential; it had to be quiet in operation and all possible parts enclosed. There was also required storage space for lathe attachments, hand tools and miscellaneous small supplies.

The table shown in the accompanying photographs and drawings was built to meet these conditions, and in several months' use has proved entirely satisfactory.

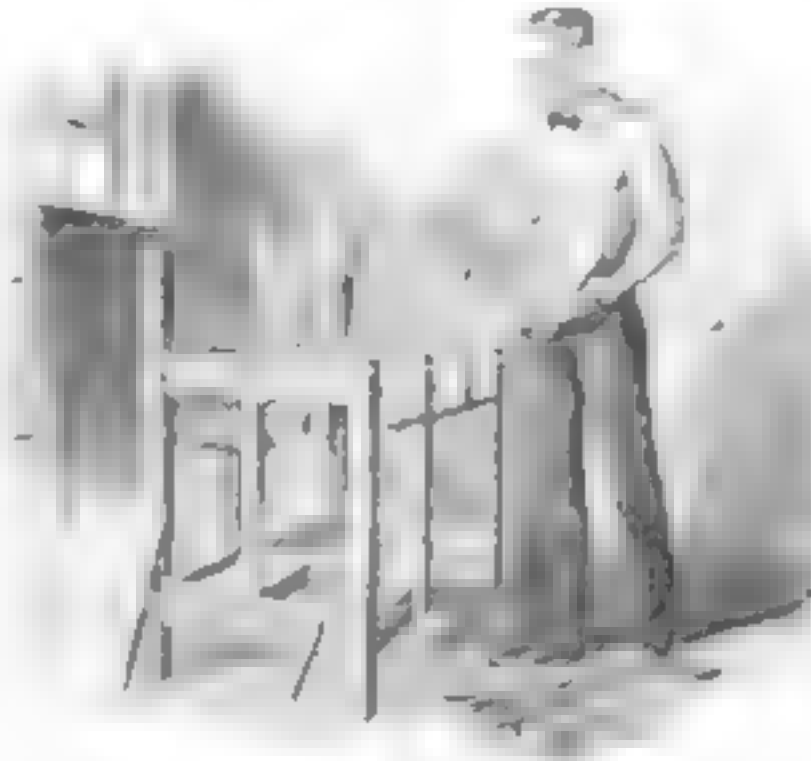
The dimensions shown are suitable for a bench lathe taking work 12 in. long between centers, and driven by a one-quarter-horsepower motor of average size. Needless to say, these dimensions must be checked for other installations.

THE table top is of sufficient size to accommodate also a grinding head and a small drill press, which are mounted so as to be easily portable. These are not shown in the photographs.

Any suitable hardwood may be used for the construction. Oak is possibly the best. Yellow pine costs less and will be found a little easier to work; it is entirely suitable. Be sure to get well-seasoned lumber. The panels, doors and divisions in the locker space, and the drawers (except the fronts) may be of soft wood, such as white pine. The drawer bottoms are of plywood, $\frac{1}{4}$ in. thick.

The finish of the table is a matter of taste. The writer stained his with walnut oil stain and applied three coats of varnish. The interior parts were given three coats of shellac.

If the dimensions shown do not



The framework for the lathe table is easy to assemble, as the joints are drawn together with screws, after which the holes are plugged.

meet your requirements, it will be necessary to prepare a dimensioned drawing. Then you may order the material from the mill, finished four sides. Many of the

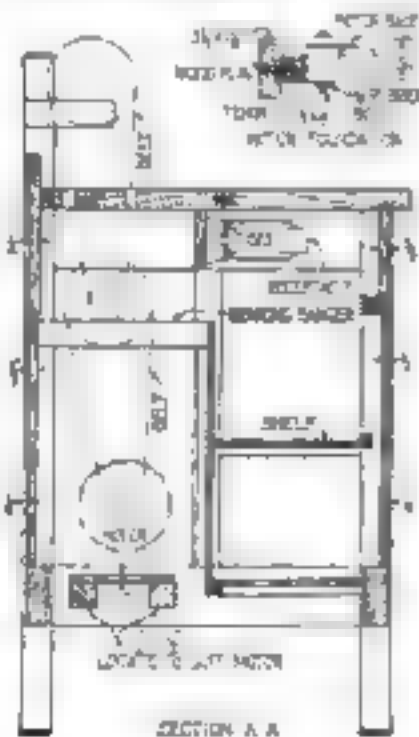
pieces may be combined and ordered in long lengths. Be sure to allow for tenons and squaring up. The top, which is $1\frac{1}{2}$ in. thick, is shown in two pieces with a spline in the joint.

ALL the principal joints are mortised and tenoned, and fastened with No. 12 wood screws, $1\frac{1}{2}$ in. long. The screw holes are counterbored to receive the heads of the screws and filled with wood plugs. These joints are easier to make and stronger than concealed fastenings, and in an article of this nature it is immaterial whether or not the plugs show. In a painted job, of course, the plugs would not be seen.

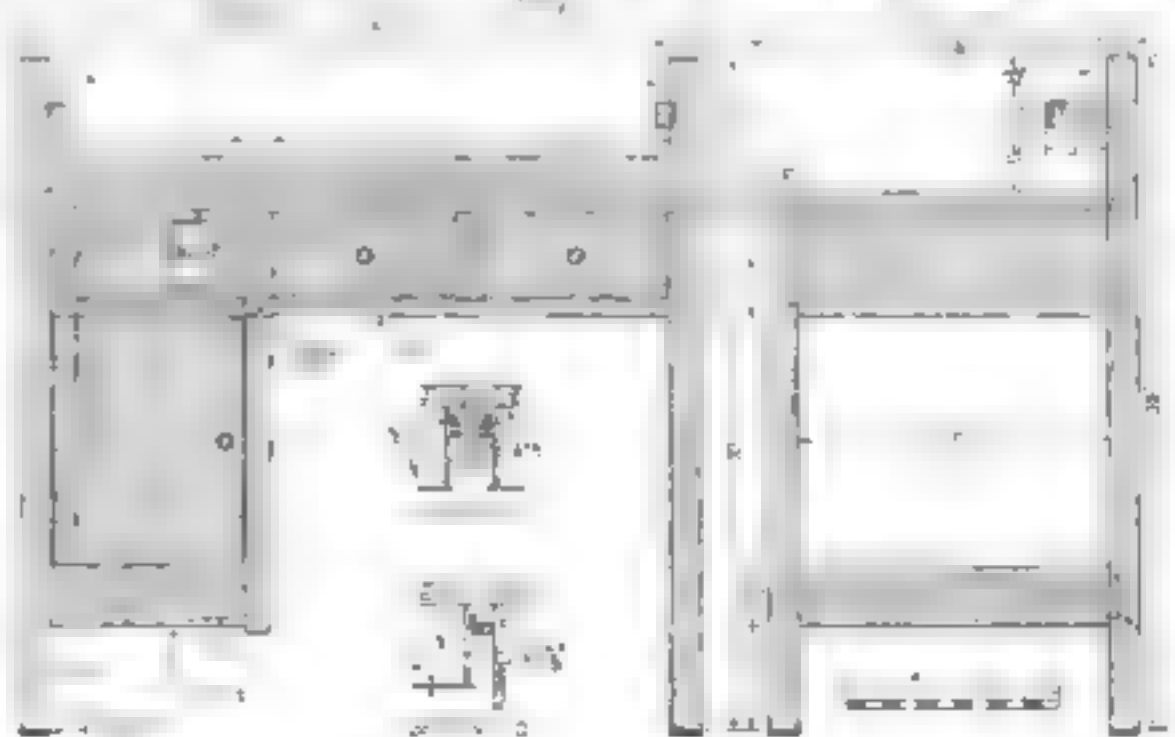
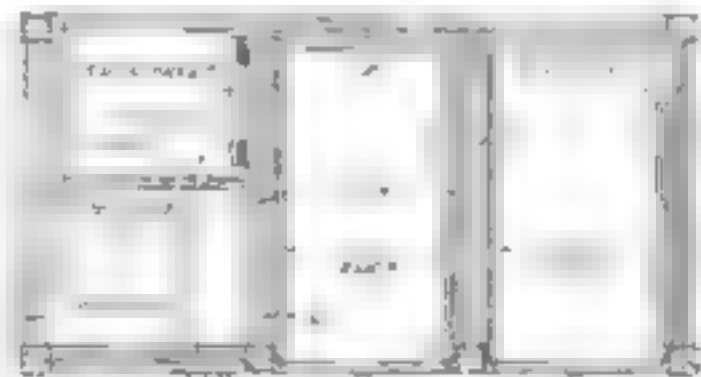
Because the left end of the bench is shown so clearly in a photograph on the opposite page, a sectional view through the locker and motor compartment is used in the drawings below instead of a left-hand elevation. The left end is similar to the right except that the upper rail is $1\frac{1}{2}$ by $4\frac{1}{2}$ by 18 $\frac{1}{4}$ in. and there

is a dividing piece 1 by 12 $\frac{1}{2}$ by 18 $\frac{1}{4}$ in. between the upper and lower rails. At the rear of the locker is a door $\frac{1}{2}$ by 8 by 17 in., and at the right is a door 11 by 14 $\frac{1}{2}$ in.

At the rear of the motor compartment the right-hand door is mounted. Details are shown in the drawings.



Working drawings of the table and details of drawer runs and motor foundation. Note the method of wiring, the



convenient switch at the front of the bench for controlling the motor, and the provision for connecting a light

may be laid out first and the tenons cut. Be sure all joints are square and each piece is of correct length. Then square up the legs and lay off and cut the mortises. Fit the tenons to their respective mortises and mark each for identification. Locate the fastenings and bore $\frac{1}{4}$ -in. holes about $\frac{1}{2}$ in. deep and then bore for the screws.

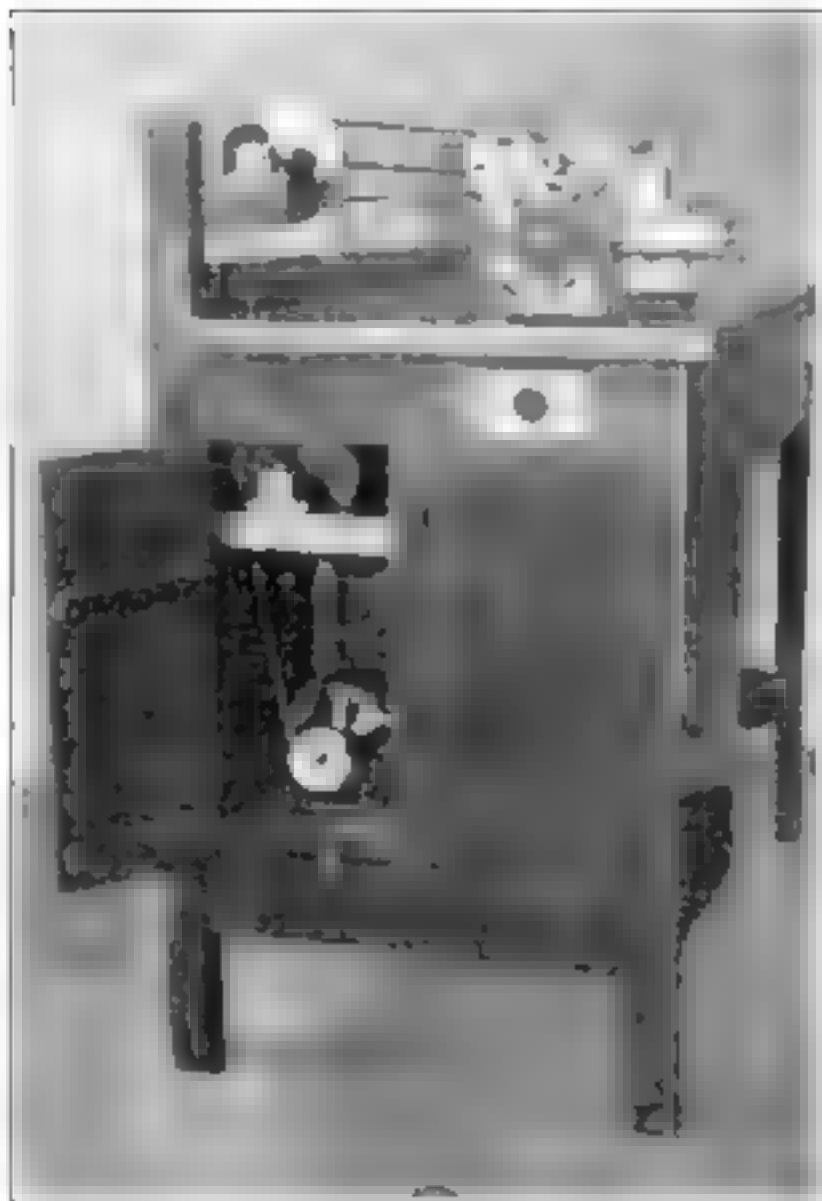
AFTER this part of the work is finished, it will be well to sandpaper all pieces. Assemble the two ends first, using a good glue in all the joints. Draw up with the screws and then wipe off the excess glue with a wet rag. The front and back rails come next, then the motor compartment and foundation. After the fastenings are all set up, the holes may be plugged with $\frac{1}{2}$ -in. wood bungs.

Now fit the hangers for the motor shaft bearings and bore for the bearing bolts. Locate the motor and bore holes for the bolts.

Put in the panels and finish up the locker. Then fit a block for the fuse base. Make the drawers and fit the drawer slides. The doors may be fitted and the hinges located, but do not hang them until after finishing.

LOCATE the receptacle and switch and fit them in place, also the fuse base and an outlet for the motor and another for the light. The scheme of wiring is shown in one of the drawings. Notice that the switch controls the motor only. Use heavy stranded copper wire well insulated, and solder and tape all joints. The fuses are of ten amperes.

Now you are ready to fit the top, and if this is in one piece, so much the better. Countersink for the screws and drill the holes at a slight angle so as to draw the joints tight when the screws are driven up. Use No. 12 screws $2\frac{1}{4}$ in. long for the top.



End view of completed table. The motor, shaft bearings, and lathe rest on $\frac{1}{2}$ in. thick rubber to do away with vibration.

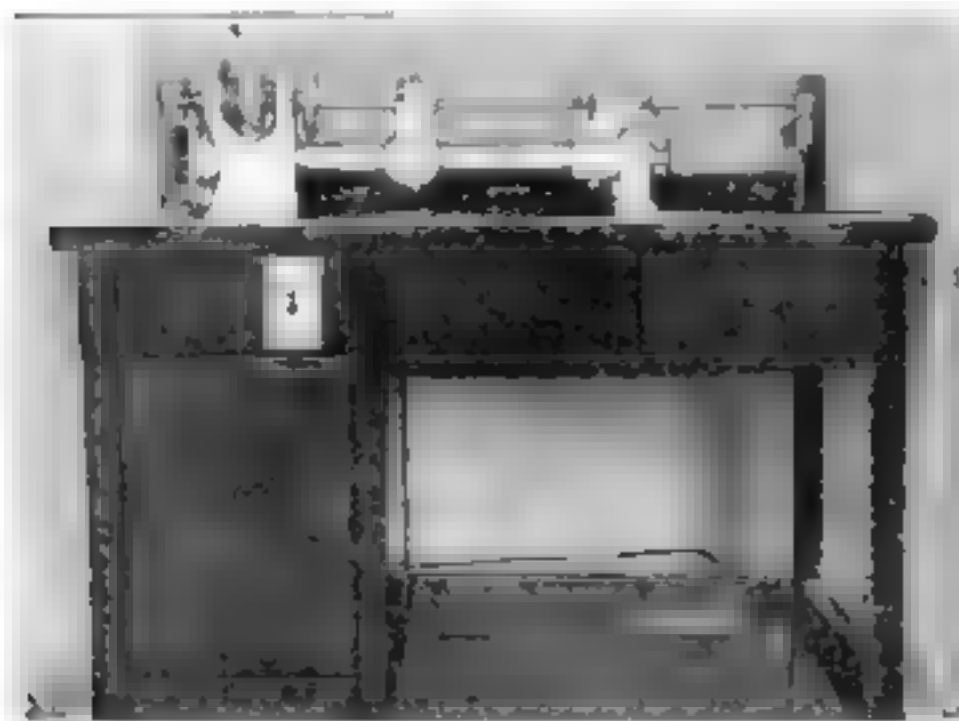
After planing and sanding the top smooth, fit the hangers for the countershaft bearings.

You can now locate the lathe and bore holes for fastening it. Locate and cut holes in the top for the belt to pass through. Fasten $\frac{1}{4}$ in. thick rubber on the bottom end of each bench leg, and put $\frac{1}{2}$ in. thick rubber under the motor, all bearings and the lathe. Sandpaper smooth and finish as desired; then hang the doors, put on the drawer pulls and the plates for the receptacle and switch.

The bearings, four in number are of the conventional pillow block type. In this instance they were made of Babbitt metal. The shafts are of steel $\frac{5}{8}$ in. in diameter.

The speed of the motor is 1750 R.P.M.

It is fitted with a grooved $2\frac{1}{4}$ -in. pulley. Two pulleys 5 in. in diameter and one 2 in. in diameter grooved for a round belt and bored for a $\frac{1}{4}$ -in. shaft, were bought and arranged as shown. The countershaft speed is 315 R.P.M. A cone pulley having the same diameters as the lathe cone was fitted on the countershaft, this arrangement gives the lathe spindle speeds of 100, 315, and 570 R.P.M. without using the back gears.



Compartments and neatness are achieved by eliminating the usual overhead countershaft. There is room at the right end for a small drill or grinder.

A New Way to Hide Wallboard Joints

WHEN fiber wallboard is to be covered with wall paper or with the easily applied plastic paints that are now so popular, the average home worker is puzzled as to the best way to make sure the joints will not crack open in the course of time and disfigure the walls.

If panel strips are used to cover the joints, the shrinkage and expansion of the boards does not matter, but in cases where panel strips are not desirable, the problem of concealing the joints permanently is a difficult one.

What is claimed to be an effective method of treating joints was recently developed in the research department of the manufacturer of a thick type of fiber wallboard. The boards are nailed up in the usual way with $1\frac{3}{4}$ -in. galvanized roofing nails having $\frac{3}{8}$ -in. heads, spaced about 3 in. apart along the edges and 6 in. along intermediate studs.

After being smoothed with coarse sandpaper, the joints are painted with a gesso or putty mixture prepared in the proportions of 5 lbs. balled whiting, $\frac{1}{2}$ gal. liquid glue, $\frac{1}{4}$ pt. oil paint of any light color, and $\frac{1}{4}$ pt. linseed oil.

A strip of common galvanized insect screening (wire cloth) is applied over the gesso immediately and the paste is worked through and over the mesh with a few strokes of a trowel or painter's scraper. After the gesso has been troweled smoothly off for 2 or 3 in. on each side, the extra thickness is hardly noticeable.

At the corners of the room a 6-in. strip of screening is bent to a right angle and similarly cemented in place. All exposed ends are pointed up with the gesso. Then, before the wall is to be papered, a coat of paper hanger's size is applied.

A WALL prepared in this way is not of course, as smooth as plaster, therefore a heavy and rather rough paper with a bold figure is best.

When plastic paint is to be used on the wall, the strips of screening are fastened on with the paint itself. The paint is applied on top and pressed through the mesh with a painter's scraper. After the nails have been pointed up, the plastic paint may be spread over the entire surface.

How to use plastic paint was told in our January and April, 1927, issues.

Turning Wooden Segments

IN TURNING a wooden article which is composed of two or more segments, it is difficult, if not impossible, to turn the piece first and afterward split it up. That is especially true if an odd number of segments are required and the object must still retain a perfect circular cross section. To overcome this difficulty, the pieces are made up with the correct center angle and then glued together with heavy paper, such as draftsman's detail paper, between each of the segments. After the whole is thoroughly dry, it may be turned and the segments separated. Gluing parts with paper between is, indeed, a trick frequently used by cabinetmakers.

The Latest in Block Puzzles

For all members of the family—A novel, fascinating pastime

Certainly you can solve it! This is at once one of the simplest and most intriguing of block puzzles; indeed, many puzzles in one. And there are more of them—a whole collection of ever-tantalizing block puzzles, with solutions on our Blueprint No. 65 (see box on page 101).

entire outfit can be made in the course of an hour or so. The paper on the cigar box should be scraped or sanded off. The bottom (E) is 5 in. square. On this is glued a frame (D) of $\frac{1}{2}$ in. wide strips, making the inside measure of the box $\frac{1}{2}$ in. square. On this is glued an open-end frame (C) of $\frac{1}{4}$ -in. strips flush with the sides and one end of the box. Above this, also flush with the sides and end, is glued another open-end frame (B) of $\frac{1}{2}$ -in. strips. This forms a box with a groove for a sliding cover (A) $4\frac{1}{2}$ by $4\frac{1}{2}$ in., on the end of which is glued a strip $\frac{1}{2}$ by 4 in. Instead of glue, the nails of the cigar box may be used to fasten the parts together.

The blocks for the puzzle must not fit tightly; they should be made so as to slide easily into the various positions.

THE constructor may make a more elaborate and finished box than this if he desires and it will be well worth the effort. The size of the puzzle may be either larger or smaller. If something still more simple is desired, the puzzle may be cut out of cardboard. There should be a bottom with a $\frac{1}{2}$ -in. frame of the same cardboard glued on to hold the pieces in position. The darker blocks may be blackened with a pencil.

In devising other forms (such as the SC position shown in Fig. 4) for the second position, some may be found in which it is impossible to move the blocks. The oblong piece is especially obstinate in blocking the way of progress, and for certain figures it may be necessary to saw it into two pieces.

The solution of the PS puzzle will be published in the July issue. It is also to be found on our Blueprint No. 65, now ready, which illustrates a number of other fascinating yet simple block puzzles of various types. (See page 101.)

By ARTHUR L. SMITH

PUZZLES of the flat moving block type, which are now so popular, are always of absorbing interest until solved. The one here illustrated should retain its interest longer than the ordinary puzzles because it assumes the form of a fascinating game. After the solution of the problem as first suggested is mastered, the solver can devise other letter or geometrical forms into which the blocks may be moved from their Greek cross position (Fig. 2). Thus it becomes many puzzles in one and an endless source of amusement.

There are 11 blocks: 8 are 1 in. square; 2 are L-shaped with 2 in. arms; one is oblong 1 by 2 in. The two L-shaped blocks, the oblong one, and four of the 1 in. square blocks are preferably darker than the others. The blocks may be painted or stained, or two woods of different colors may be used.

The blocks are placed in a box so that the darker ones form a Greek cross and two of the lighter ones are removed as in Fig. 2. These two blocks are merely to prevent disarrangement of the others when the puzzle is put away.

THE problem is to move the blocks from the first position to form the letters "PS" (POPULAR SCIENCE) as shown in Fig. 3. The blocks are not to be lifted out or twisted around, and the box is not to be reversed.

Those who find the puzzle easy to solve in this form, will find it more difficult to work it backward, from the PS position to the Greek cross.

A simple method of making a box with a sliding cover for this puzzle is illustrated in Fig. 1. With a sharp knife or a fine saw and an empty cigar box or two, the

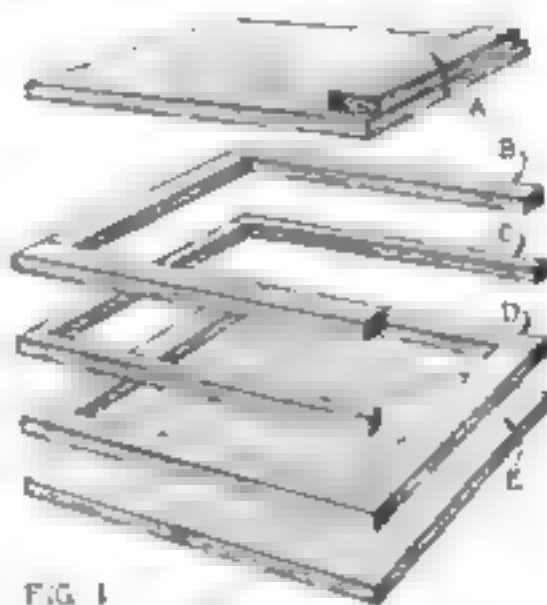
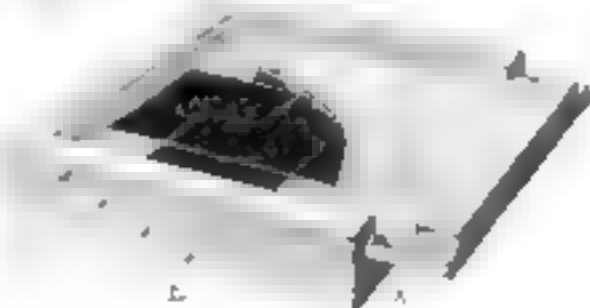


FIG. 1



An especially easy way to make a neat box for the puzzle. Cigar box wood may be used.

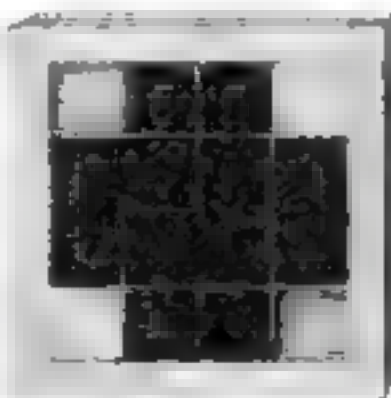


FIG. 2

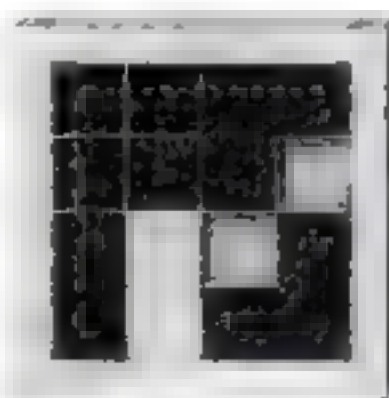


FIG. 3

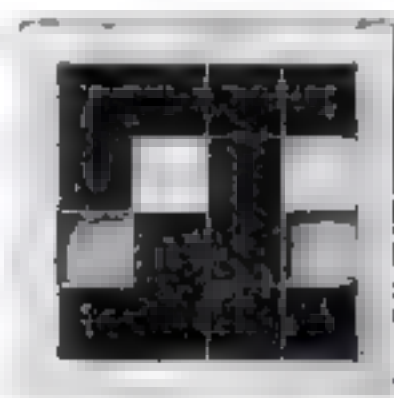
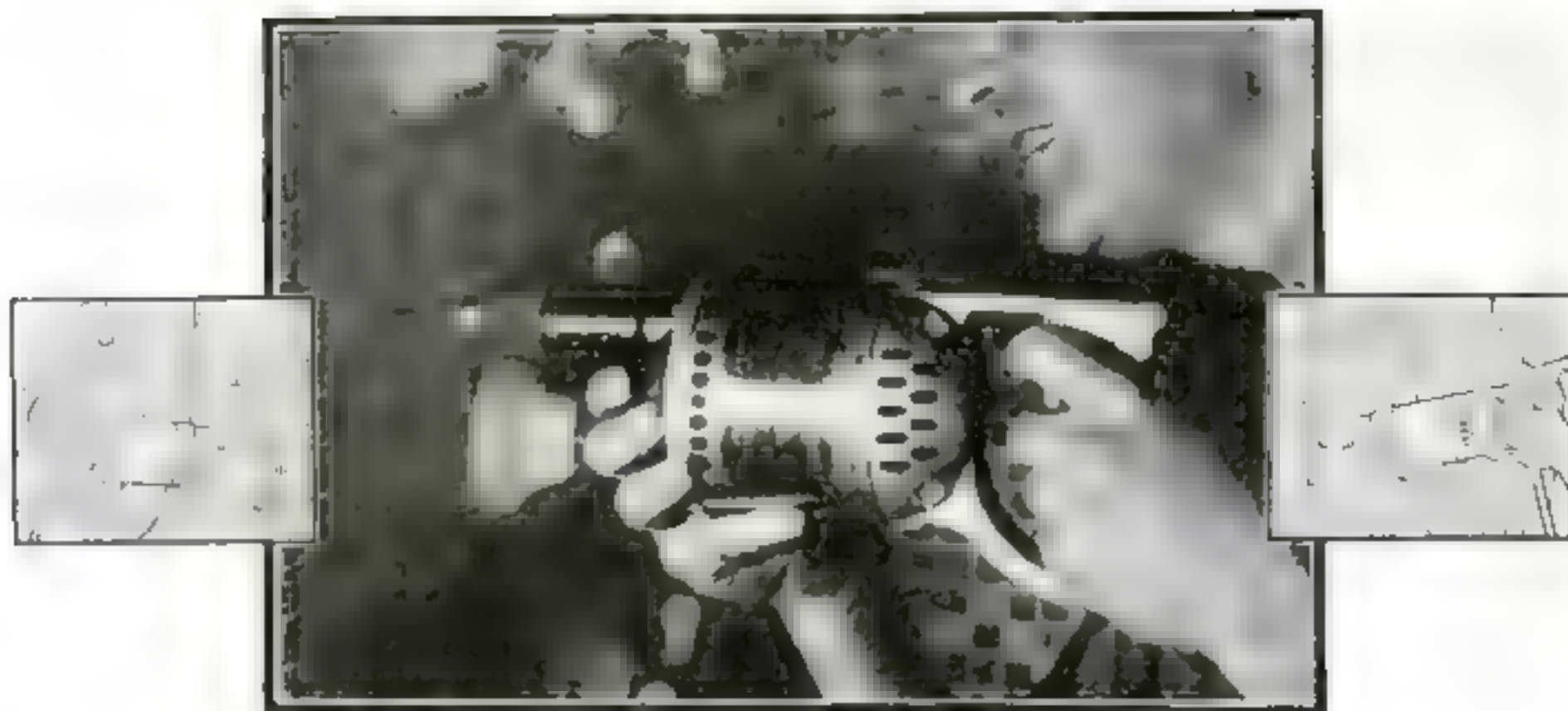


FIG. 4

The blocks are arranged first to form a Greek cross (Fig. 2) and are moved by sliding them from place to place to form a shape similar to the letters PS (Fig. 3) or the letters SC (Fig. 4).



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New Fishing Rods for Old

How to Repair, Rewind and Refinish Split Bamboo

By ROBERT PAGE LINCOLN

TRILY can it be said that a fishing rod is as good as the care you have given it. Even a cheap machine-made bait rod, if kept in good repair, will be equal eventually to a high priced rod that has been neglected.

A rod may be in a good, indifferent or bad condition when you go about repairing it. Often when it is otherwise in satisfactory condition the tip of the rod will have acquired a "set" or downward bend and they must be made straight.

Varnishing, at the very least, should be an annual practice. It does not need more than one worn patch on the rod to invite disaster. Moisture will get in and part the strips of which the rod is made. Then, perhaps in the midst of a struggle with a choice fish, the rod will snap.

If a rod is in good condition save for the varnish, the original windings can be left on. If the windings are worn, it is best to take them off and scrape the rod.

Old rods are apt to have strips unglued up and down from the ferrules for perhaps 4 in. After removing the ferrules, as shown in one of the illustrations on this page, spread the strips and re-glue with a rod-maker's glue, which can be obtained at almost any sporting goods store. Wind the whole length of the newly glued section with fishine and allow to dry for a week or two before scraping.

Let us use for example a rod that is in an indifferent condition, with worn patches, frayed windings and a set to the tip. Incidentally, there is no need of your tips becoming set. Even though every rod is supplied with an extra tip, many fishermen will use one tip continually, with the inevitable result that the strain breaks it down. Every fisherman should have two extra tips for his fly rod handle: one on the rod. One tip is used one day, the second the next day, and the remaining tip the third day.

ONE should never leave the jointed rod hanging on nails along the walls of a cabin or cottage, as the tip will bend down. The rod, therefore, should always be taken down at night and carefully wiped dry. In the case of a bamboo bait rod, tie a weight (not too heavy) at the handle, fasten a cord to the tiptop guide, and hang it to a hook in the ceiling. In this manner you can protect the tip piece from taking on any set. Even a bait rod should have at least one extra tip.



During the time the rod is bent, the tip will be straightened.



To remove a ferrule, hold it against a hot iron, as indicated above, to soften the cement. This also is a safe way to loosen the uppermost or tiptop guide.

Rod windings generally are started on the butt section right with several broad bands placed just above the handgrip.



No tip can be materially strengthened without removing the windings and the guides. Having done this, take the tip in hand and easily and gradually work the bow out of it by bending it the other way. Pass it occasionally close to some mild source of heat to soften it a trifle, too much heat will be ruinous. The tip then is suspended from the ceiling with a weight tied to the lower end and left for a week or two.

The guides are reinstalled directly opposite their former positions so that their pull will be against the previous set or bow.

Ordinarily the windings in between the guides on a fly-rod tip are narrow, no more than five or six turns of silk thread. In rewinding, a tip strength is gained by increasing the width of these bands to about ten turns. How to make the windings will be explained in detail a little later on.

WHEN the tip is varnished and dry, joint it up with the rod and bend it downward a little at a time by working the tip alone. Then use the full-length play of the rod, with the line threaded through the guides and tied to some stationary object. This is to get the tip limbered up.

If your rod is to be completely re-wound and refinished, the old varnish must be removed. A safety razor blade is a good tool for this. Carefully cut through the silk windings and strip them off, then scrape the varnish. Never go deeper than the varnish, since the hard outer skin of the bamboo is its strength and must not be harmed.

Be sure to make a preliminary drawing of each rod joint to show where every guide and winding goes, and make a pin prick on the rod itself at the exact center of each eye.

Care should be observed in removing the ferrules and the tiptop guide, if, indeed, they must be removed. Heat the ferrule over a match flame or, better, heat an iron red-hot and turn the ferrule around on the iron. The flame of a match is especially likely to injure the bamboo close to the sleeve of the tiptop guide, and the hot iron method is safer.

To cement the ferrule on again, heat the wood over which the ferrule goes with a match or over a fire and heat the ferrule also.

Mix the ferrule cement, which comes in stick form, on to the wood with a match and slip the heated ferrule home with a quarter twist.

To return to the varnishing operations, go over the scraped rod with the finest grained sandpaper to be had. (Continued on page 82)

No. 1042

$\frac{1}{2}$ " Heavy Duty—110 Volt A. C. or D. C.
No-load speed 1800 R.P.M. Weight, 6
pounds. **Costs only**\$36.00



Goes through *cold rolled steel*

just as your Hand Drill goes through soft pine

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No. 1042 costs only\$36.00



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Universal Motor Runs on 110 Volts A. C. or D. C. Also made for 220 Volts.

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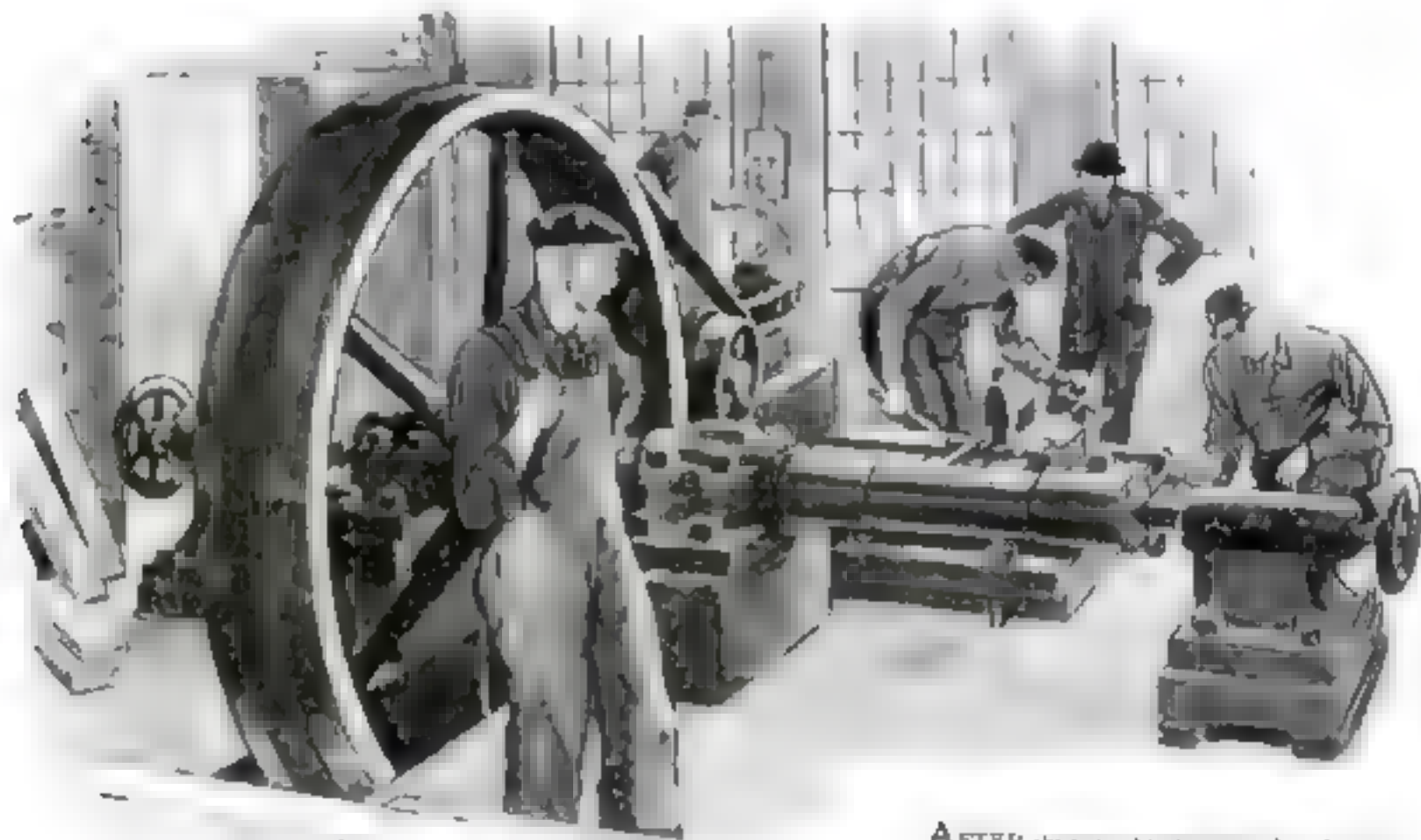
1500 GOOD TOOLS



A Job Too Big for a Lathe

*Yet Old Bill Had to Turn the Mill Shaft Quickly
How He Did It May Help You Solve Similar Problems*

By JAMES ELLIS



AFTER showing the shop crew how to set up the hand mill shaft, Old Bill watched while the badly scored journals were turned.

OLD BILL went to meet the office man, who was hurrying through the shop toward him. "What now?" he asked.

"The Binklers want you to come out to their saw mill as soon as you can. The shaft on the hand mill is scored badly because it ran hot, and they can't get the wheel off so they can send the shaft to the shop."

Old Bill knew the concern. A large establishment with a shop of its own, it sent out the more difficult jobs to him. He knew that the problem must be a real one if it stumped the Binklers' capable shop crew, so he prepared to drive to the plant, which was ten miles out of town.

He had plenty of opportunity to muse about things in general as he drove for

there was little traffic on the road, and the spring air made motoring pleasant. All too soon he was at the mill.

"This wheel is supposed to come off the shaft easily," the mill foreman explained, "but we have tried it with a twenty-five-ton jack, and can't do a thing with it. We wanted to know if you could arrange to turn the shaft without taking off the wheel."

Old Bill studied the wheel. Eight feet in diameter, and about four tons! Not a lathe within 200 miles that would swing it! Not even the wheel lathe in the railroad shop, for the shaft was too long.

Old Bill pondered these facts, and then started for an apparently aimless walk. The mill foreman followed and Old Bill answered categorically the

questions put to him. "Yes" or "no" was the only response he gave, for he was thinking. Finally he said, "We can turn the shaft here as well as any other place."

The mill foreman and the shop's much-mist Edward Lamons, looked at him blankly.

"What? Why, we have no lathe that will take anything nearly as large as that!" the mill foreman exclaimed, somewhat heatedly. "The largest lathe we have is only twenty-eight inches, and the other's only twenty."

The foreman's *(Continued on page 113)*

MANY time-saving shop ideas are contained in the continuation of the Better Shop Methods Department, to be found on pages 109 to 118.

"I look for 'em in the Starrett Catalog"



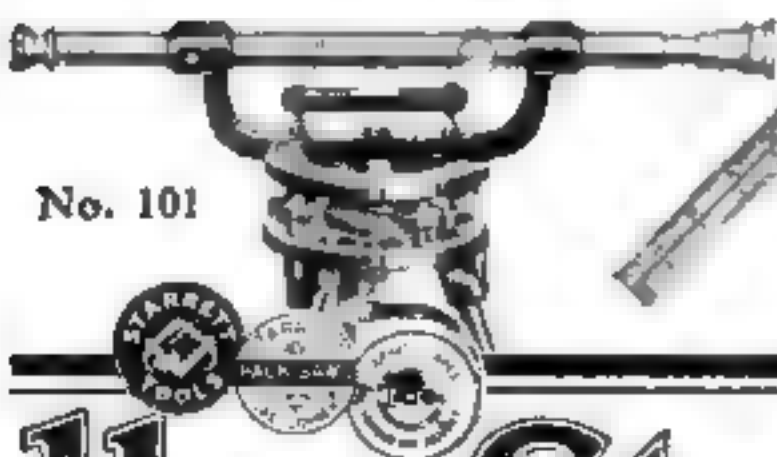
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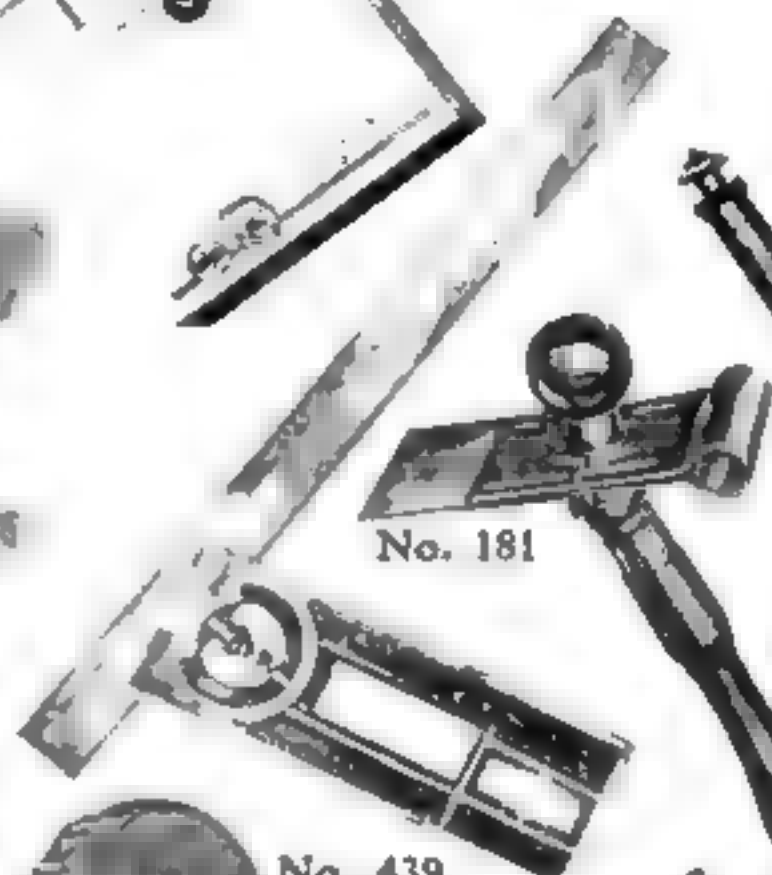
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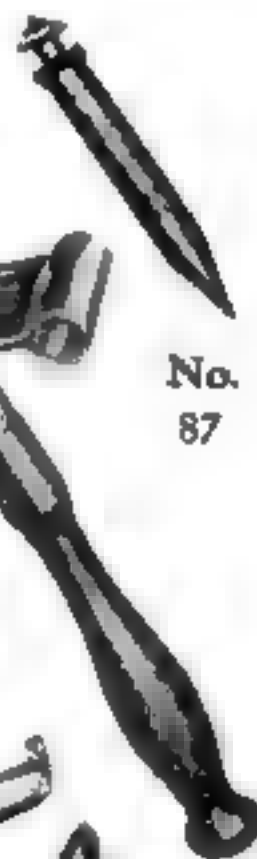
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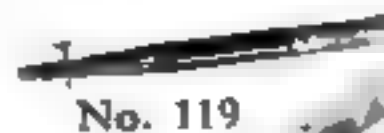


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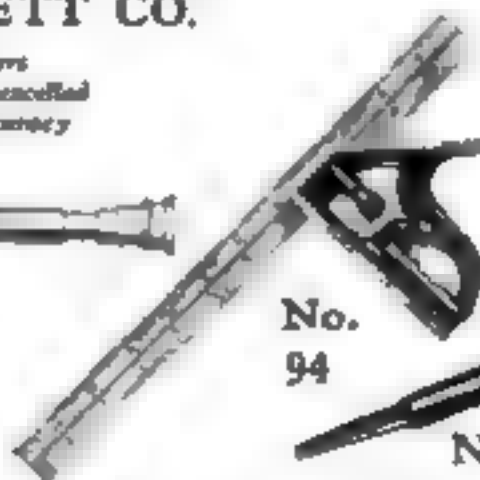


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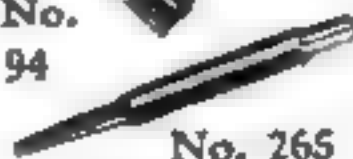
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per now and expect to use it for some time to come. I shave every morning and the old 'bristles' are as tough as any of 'em." (Signed)

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Stroppers

How to Replace an Old Electric Light Bracket with a Sconce

By GEORGE A. WILLOUGHBY

ARTISTIC electric wall sconces can easily be installed in place of old-fashioned brackets which have become defective, shabby or otherwise unsuitable.

The first step before starting this or any other type of repair or replacement work is to open the main house switch. Then to remove the old bracket (Fig. 3), loosen the screw holding the canopy, and pull the canopy from the wall to expose the fixture support and the connections.

Cut the fixture wires and unscrew the bracket, or, if necessary, first remove the screws holding the crow-foot or fixture stud and cut the fixture wires after the fixture has been pulled from the wall.

The next step is to provide a good support for the new sconce. The simplest way is to install the special stud furnished with the sconce by attaching it to the wall with three wood screws as in Fig. 2, but this is not necessarily the best. In some old installations where the crow-foot is attached to lath, it is a great improvement to substitute a suitable outlet box (Fig. 4) such as now is used in good installations. It provides a fireproof enclosure for the wires and a more rigid support for the fixture.

Select a shallow box which when attached to the lath will be flush with the plaster or extend slightly in front of it. It must be provided with knock outs for lath so the lath-covered wires can be brought into the box and clamped in place, as illustrated. The fixture stud

may be attached to the box with stove bolts or it may be screwed to the lath through openings in the box. Additional screw holes in the box make a rigid installation possible. Hold the box on the wall where it is to be installed and carefully cut around it with a small, sharp screw driver or knife so the plaster can be removed from the space within the circle. After the plaster has been removed, bring the lath-covered wires into the box and attach the box securely.

The stud furnished with the sconce is threaded to fit a fixture stud, or it may be used in place of a fixture stud.

After the fixture support has been provided, remove covering from the ends and clean the wires for making the connections. The joints should be made as



Fig. 1. It is a simple matter to substitute an artistic sconce for an old-fashioned bracket.



Fig. 3. The first step in removing the old fixture is to loosen the canopy.



Fig. 2. Screwing to the wall the special stud furnished with the new sconce.

illustrated in Fig. 4 and soldered and served with rubber tape (or splicing compound), and a serving of friction tape, wound in the opposite direction. Then attach the sconce (Fig. 1).

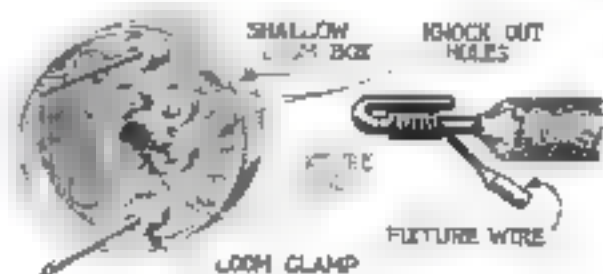
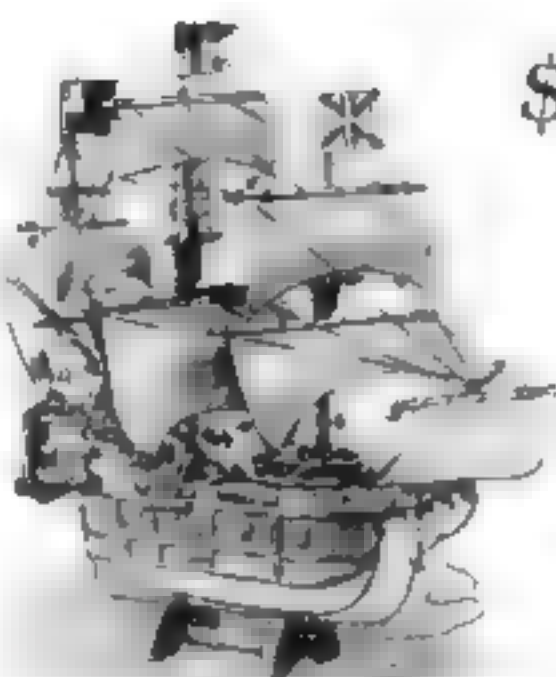


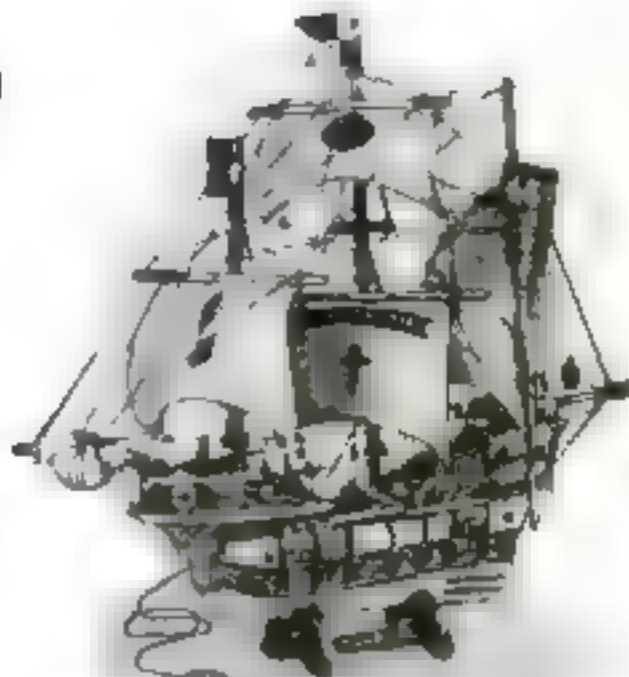
Fig. 4. An excellent type of outlet box for this work method of connecting wires.

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Height 23"
Width 11"
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The unassembled parts for either the Santa Maria or Mayflower Model, without the MELODY SAIL attachment, can be had for \$4.99 plus postage. Full detailed diagram and instruction sheet showing and explaining every operation for completing the Model supplied with each.

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GUARANTEE If, after assembling the MELODY SHIP, you do not think it worth many times its purchase price return it to us in good condition and we will gladly refund your money. What can be fairer than this?

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SHIP MODEL only	4.99
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(Be sure to indicate whether you want Santa Maria or Mayflower Model.)

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MINIATURE SHIP MODELS

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Pipe Smoker Risks Life Finding Can of Favorite Tobacco

Over a period of years, we have heard of many ways in which pipe-smokers prove their devotion to their favorite tobacco.

But the medal certainly goes to Joseph P. Fink of Darby, Pa.

His letter follows:

Darby, Pa.
November 2, 1926

Larus & Brother Co.
Richmond, Va.
Gentlemen:

I have the honor of writing you in regard to the Sheddards Valley of Virginia.

I have a mission for you. I am a member of a pipe-smoking club and I am the only one of my kind in the town of Darby, Pa. I am a pipe-smoker and I am a member of a pipe-smoking club. I am a pipe-smoker and I am a member of a pipe-smoking club.

I am a pipe-smoker and I am a member of a pipe-smoking club. I am a pipe-smoker and I am a member of a pipe-smoking club. I am a pipe-smoker and I am a member of a pipe-smoking club.

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I am a pipe-smoker and I am a member of a pipe-smoking club. I am a pipe-smoker and I am a member of a pipe-smoking club. I am a pipe-smoker and I am a member of a pipe-smoking club.

Very respectfully,
Joseph P. Fink



Let us send you free samples of Edgeworth so that you may put it to the pipe test. If you like the sample, you'll like Edgeworth wherever you buy it. It never changes in quality.

Write your name and address to Larus & Brother Company, 10 N. 21st Street, Richmond, Va.

We will be grateful for the name and address of your tobacco dealer, too, if you care to add them.

Edgeworth is sold in various sizes to suit the needs and means of all pipe smokers. Both Edgeworth Plug Size and Edgeworth Ready-Rubbed are packed in small pocket size packages, in handsome humidor holding a pound, and also in several handy in-between sizes.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen cartons of any size of Edgeworth Plug Size or Edgeworth Ready-Rubbed for the same price you would pay the jobber.

{ On your radio tune in on WRF 8, Richmond, Va., the Edgeworth Station. We are length 256 meters. }

A Circular Saw Attachment for Your Tool Grinder

By EDWARD THATCHER

FOR the home shop not fitted with a power driven saw, the hand operated circular saw illustrated will be found most handy. The whole cost of the one shown was \$3.80, which included the grinder and two circular saws, one for ripping and the other for crosscutting. If you have a

of thin wood with any degree of accuracy by hand, but with this machine any wood up to $\frac{1}{4}$ in. thick can be cut into uniform strips; grooves may be made with and across the grain; and soft wood up to 1 in. thick may be crosscut, if the saw is well sharpened and set.

By making a special washer (Fig. 8) to cause the saw to wobble, it is possible to cut grooves $\frac{1}{4}$ in. wide. Indeed, if you have no other device for grooving, you will find it worth while to make the attach-



Fig. 1. Hand driven saw for cutting and grooving ship model parts and small work.

grinder, the only expense will be for the saws. The remainder of the materials usually can be found about the shop.

While this little saw table is not for handling the heavier sort of work cut with a power saw, it is most useful for the smaller pieces of wood such as are used by ship model builders, toy makers and those interested in the lighter form of construction (Fig. 4).

It is rather difficult to rip narrow strips

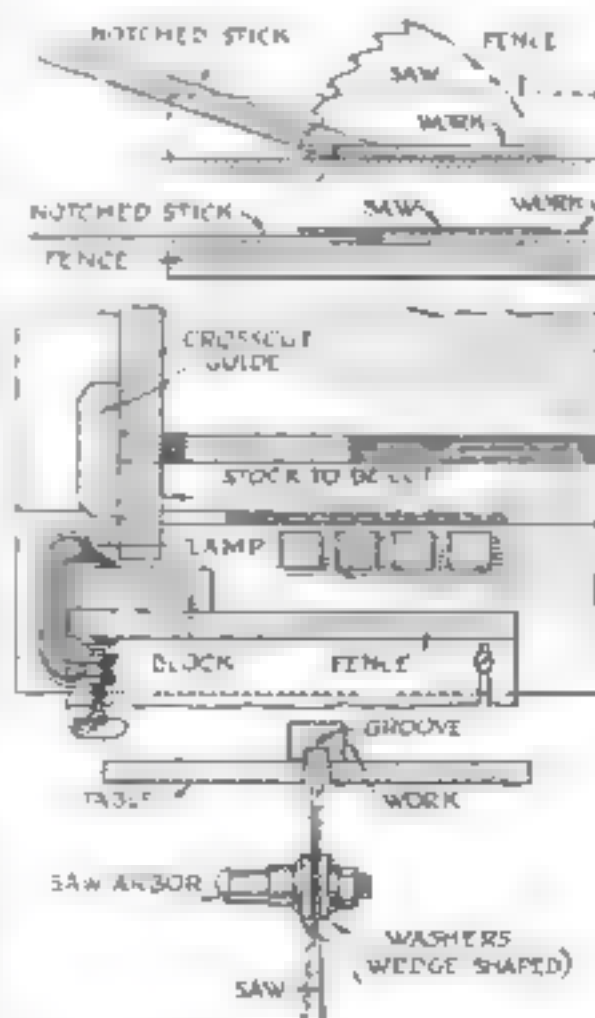


Fig. 3. How to rip narrow strips, cut off small blocks, and do grooving with a saw.

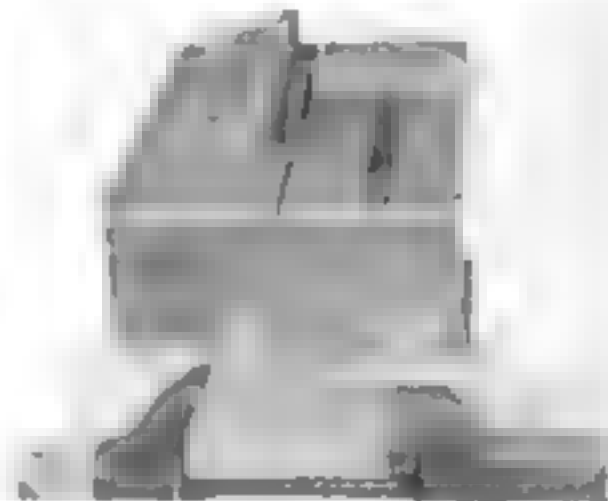


Fig. 2. The saw from the rear showing crosscut guide and adjustable ripping fence.

ment for this operation alone. It will allow all sorts of small picture frame moldings and the like to be made.

In this instance the tool grinder had a 6 in. wheel, so 8-in. saws were ordered, with holes to fit the grinder spindle.

The saw table must correspond to the size of the grinder. In this case the baseboard was cut $\frac{1}{4}$ by 8 by 12 in. and under it was screwed a piece $\frac{1}{4}$ by $3\frac{1}{4}$ by 15 in., for the vise jaws to grip.

The table, which may be made of pine, whitewood or maple, is $\frac{1}{4}$ by $8\frac{1}{4}$ by 14 in. It is really in two pieces, divided by the saw, as shown in Fig. 2. One piece is provided with a shallow groove for the tongue of the crosscut guide, which slides back and forth in it. This guide is a block of wood screwed to a length of sand iron $\frac{1}{4}$ in. wide and 3 in. long. Several screw holes may be provided in the guide so that it may be set for entering or at any angles you wish. The slot may be lubricated by rubbing a large lead pencil back and forth in it.

The ripping fence is attached to the other side of the table by means of wood screws or stove bolts. Slots are provided so that it may be set at various distances from the saw. Both pieces of which the guide is made are $\frac{1}{2}$ in. thick, one is $1\frac{1}{4}$ by 8 in. and the other, 1 by 8 in.

The end of the table is screwed to a block 1 by 3 by $8\frac{1}{4}$ in., or whatever the width of the table happens to be. This block is lugged to the base, as in Fig. 2.

Mount the grinder with the saw in place before hanging. (Continued on page 87.)

Circular Saw Attachment

(Continued from page 86)

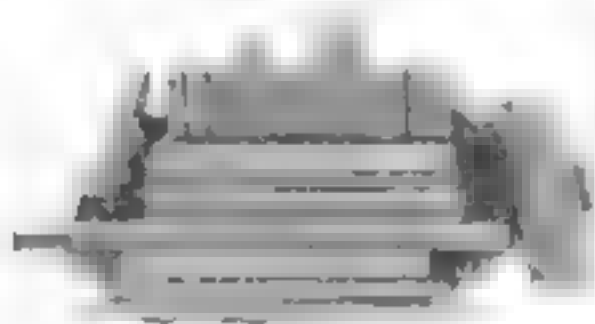


Fig. 4. This is the sort of work the saw does. Mr. Thatcher, who is a distinguished craftsman, devised the machine in an emergency when he was temporarily deprived of power in his own very completely equipped shop. He found it so useful that he keeps it handy for small model-making and similar jobs.

the table and make sure that the top is square or at right angles to the saw blade, and also that the slot for the saw runs parallel to the blade so that all work will be true and square. The table may be tilted and held at any desired angle by the grinder tool rest, as in Fig. 1. That allows the depth of the saw cut to be varied for grooving.

The slot for the crosscut guide may be made on the saw itself, provided an extra piece of wood is used temporarily on the left side of the table. Two cuts should be made and the wood removed with a chisel.

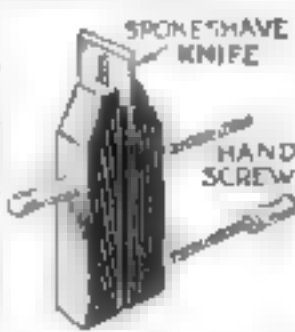
The saw should be turned up to full speed before wood is fed against it and the same precautions should be used as with any circular saw. A notched stick should be used to feed narrow strips between the saw and the ripping guide (Fig. 3). When a number of short lengths of wood are to be cut off a block should be clamped to the ripping guide and the work held at right angles to the saw with the crosscut guide, as shown in Fig. 5. This will prevent the pieces from becoming jammed between the saw and the fence, as would be apt to happen if the block were not used.

The wobble saw (Fig. 3) merely requires a wooden or Babbitt metal washer thick enough to be cut diagonally into two parts, so as to throw the saw out of line sufficiently to cut the width of the required groove.

A saw table of this kind may be adapted easily to a lathe. In that case the saw is held on a mandrel and the baseboard of the saw table is clamped to the lathe bed, suitable grooves or cleats being provided to hold it in line.

How to Hold a Spokeshave Blade for Sharpening

WHEN sharpening a spokeshave blade, there is some danger of grinding one's fingers unless some sort of a holder is used. A safe and easy way to hold the blade is with a small hand screw.



Spokeshave blade held safely for grinding.

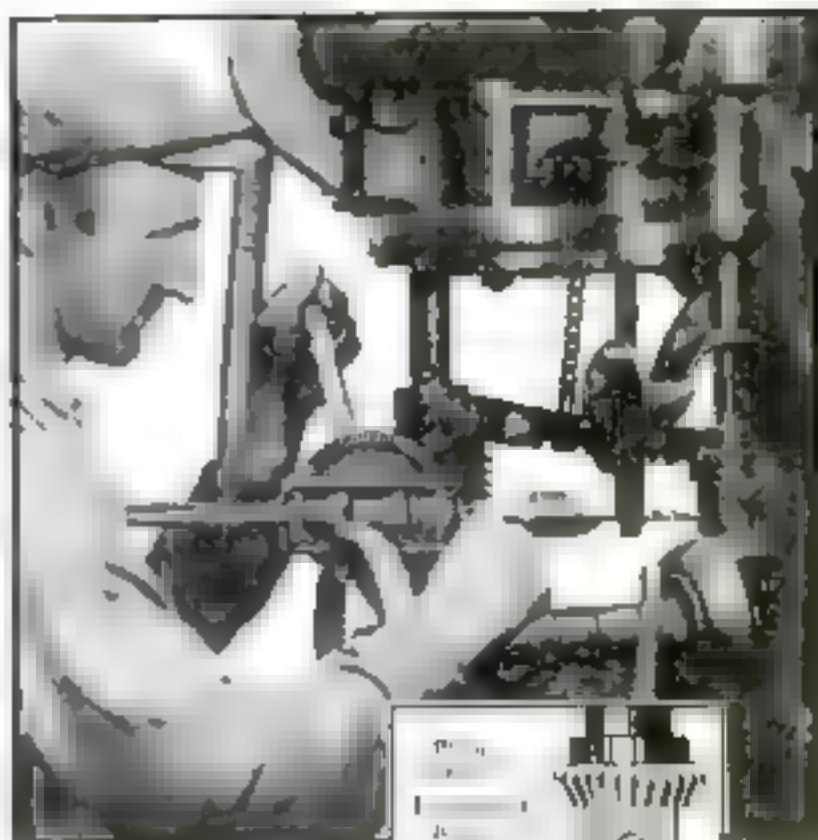


Yankee Ratchet Breast Drill No. 1555

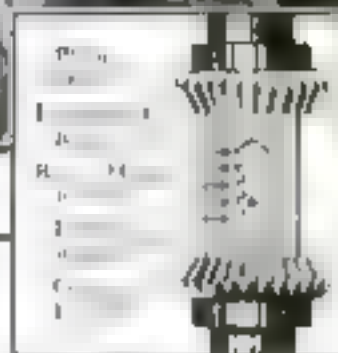


FREE New "Yankee" Tool Book

This interesting little book, for a library of five tools, is just what you want to know about the famous YANKEE Tool for making work easier and quicker.



A finger touch on Ratchet Shifter gives any one of five adjustments.



A job can't hide from "Yankee"

No. 1555

Cramped space makes little difference. Lack of room to turn the crank doesn't matter—when you use "Yankee" Ratchet Breast Drill No. 1555. For "Yankee" ingenious design uncovers the work in spite of obstructions. And nothing need be removed. No lost motion. No lost time. Simply set Shifter on DOUBLE Ratchet! Then the slightest movement of the crank, either back or forth, lets you drill continuously.

The four other ratchet adjustments shown above, and two speeds, make this "Yankee" Drill the handiest and fastest ever designed. You can change speeds instantly without removing drill from work. Just shift lever at base of hub.

Ratchet Breast Drill No. 1555 (Illustrated), 3-jaw; No. 555, 2-jaw. Hold $\frac{3}{8}$ in. Drills. Ratchet Hand Drill No. 1545, 3-jaw, No. 545, 2-jaw. Hold $\frac{3}{8}$ in.

For smaller drilling jobs use "Yankee" Ratchet Hand Drill No. 1530, with five ratchet adjustments.

Some Other "Yankee" Tools

Ratchet Bit Wrench
Spiral Screw Drivers
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Automatic Push Drills
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Dealers Everywhere Sell "Yankee" Tools.

"Yankee" on the tool you buy, means the utmost in quality, efficiency and durability.

North Bros. Mfg. Co., Philadelphia, U. S. A.

"YANKEE" TOOLS

Make Better Mechanics

You Can Trust A

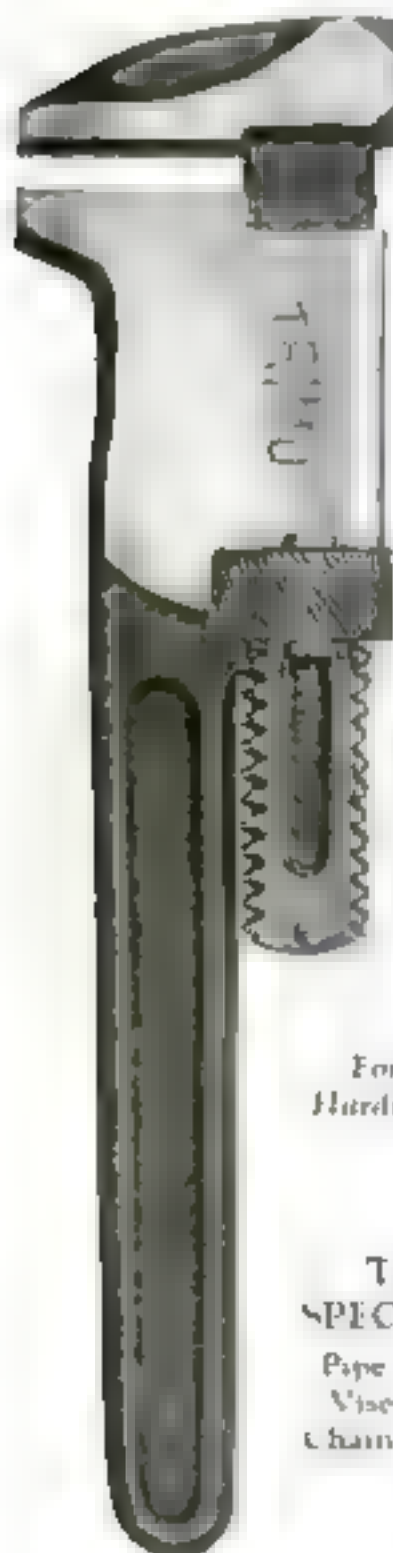
TRIMO

Monkey Wrench

Thousands of men bear with all their strength on the handles of TRIMO Monkey Wrenches, confident that a TRIMO will not let go.

It's a regular ho-wrench—strong, rugged and enduring.

There's more than brute strength to recommend TRIMO Monkey Wrenches, however, for their jaws are skillfully designed to REMAIN PARALLEL up to the far distant day that old age makes a new and younger TRIMO necessary.



Knife Handle Wrench made in sizes 6, 8, 10 and 12 inches. Steel Handle made in sizes 6 to 24 inches, inclusive.

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America's Leading Wrench Makers for Nearly
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How to Refinish Your Floors

Shellac and Wax—Clear and Dark Varnishes— Brushing Lacquer

By RALPH G. WARING



Dark varnish stain
removes an old floor

HOW shall I finish the floors of my home? Which is better, shellac or varnish? Are brushing lacquers serviceable for floors?

These and similar questions are asked endlessly in every paint store. Let us, therefore, review the various finishes. It is taken for granted, of course, that the floor to be finished has already been sand-papered and filled properly, as outlined in last month's article.

The first finish to consider is shellac and wax. This makes a beautiful finish when properly cared for, but does require constant looking after to keep it in first-class condition.

The shellac sold in paint stores should be reduced with three parts of alcohol to a quart of stock shellac. Orange shellac is preferred by some to white. It should be applied with an extra long black China bristle brush about 3 or 4 in. wide.

Considerable care and skill are necessary in using shellac. Apply it quickly and evenly with a well filled brush to not more than three or four boards at a time, starting in a far corner of the room. The strokes should be quick, even, and as few as possible, in order to avoid laps.

All work should progress from the raw boards to the finished portions in order that the stroke may be lifted up quickly at the end of the left-to-right movement. In no case should the new stroke be started on the end of the portion last finished, or heavy laps will be sure to show. By taking care and studying the results of your brushwork, your skill necessarily will increase. The most common fault is that of over brushing.

Do not apply more than two coats of shellac in an eight hour day. The final coat should dry overnight so that waxing can be started the next morning.

Either the liquid or solid floor waxes can be applied and on dark floors a dark or black wax only should be used or a gray cast is apt to appear. To color floor wax add one part dry pigment colors to four or five parts wax by volume. Powdered raw sienna, burnt umber and rose lake are suitable colors and these can be

mixed with wax to match any dark floor.

A large ball of wax can be enclosed in cloth and rubbed on the floor. Cover the entire floor before beginning to polish. This may be done either with a weighted brush made for this work or with an electric polishing brush, rented from the local hardware store. This last is, of course, a great labor saver, it produces a fine polish and is

more than worth the rental charge.

On new work it will pay to apply two coats of wax, allowing about an hour between coats to be sure the first has hardened well.

I have found that a final rub either by hand or by facing the weighted brush with a piece of good body Brussels carpet will give an extra brilliant finish.

Worn spots near the doors and on stair treads should be washed with gasoline, dried and rewaxed frequently. All exposed portions of the floor should be waxed once a month, and occasionally polished with a weighted brush.

The next type is the varnished floor. Here again we have a choice between the clear varnish, which will not affect the color of our floor as left by the filler; the dark oak varnish stain, which is pure brown; the walnut stain, which is one part red and two parts brown, and the dark mahogany varnish stain, which is equal parts of red and brown with the red tone dominant. These transparent color varnishes and materials in producing an even tone. They also have a material darkening effect on the whole floor. In general the varnish stain coat should be followed by a coat of clear varnish.

ALTHOUGH it is often claimed that a varnish will dry hard in forty-eight hours, it is necessary that as much more time be given between coats as possible. Three days is not too much and at least a week should pass before furniture and rugs are placed.

Of late years it has been possible to obtain a dull floor varnish of light color, this gives a finish without high gloss and is similar in effect to a gloss varnish which has been laboriously rubbed dull with felt, pumice stone and erude oil.

Contrasted with these finishes, we have the remarkable new finish called brushing lacquer. Here at last is a tough, durable finish that can be applied and used in a few hours rather than days or even weeks. It does have its limitations, however, and is far from being "foolproof." On a newly sanded floor,

(Continued on page 89)

How to Refinish Floors

Continued from page 55

properly filled and hardened for forty-eight hours, clear brushing lacquer, of a quality guaranteed by the manufacturer for this use, can be applied directly to the filler with a black China bristle brush with extra long bristles, made especially for lacquers. If this type cannot be obtained, a fish or ox-hair bristle brush is to be preferred, a fairly soft but full closed brush is necessary.

The manufacturer claims that this kind of lacquer will dry in thirty minutes, but after testing eleven brands, I have found none that was not somewhat sticky or tacky at the end of an hour. A floor is a ways so much coarser than the usual test panel used in the laboratory that both the initial set and hardening are much retarded. For this reason I seriously object to the application of more than three coats of lacquer in an eight-hour day. The last coat should dry overnight with heat in the room.

TO MANY the odor of brushing lacquer will be rather trying, but with free ventilation the odor will be dispersed rapidly and soon forgotten. One caution should be observed, and that is to avoid lacquering a floor in a room containing a stove with a fire. I have held a lighted match 1 in. from a panel lacquered five minutes previously without having a flash, but the solvent and air do form an explosive mixture, and because of this reasonable care should be exercised.

My experience has been that floors cleaned with varnish remover cannot be lacquered successfully. On a test floor I treated one half with caustic and the other half with varnish remover. When lacquered the caustic-treated section hardened in five to forty-five minutes, the other cleaned with varnish remover took twelve days to harden. I found upon chemical examination that enough paraffin wax remained on the floor and in the joints, in spite of careful cleaning with denatured alcohol to cause trouble with lacquer. Minute traces of grease or wax will so slow up the action of an oil that it is no better than varnish for speed. As a matter of fact, varnish applied to a dried floor previously cleaned with remover will try to a satisfactory finish on time.

WHERE the painted floor effect is desired, especially in kitchens, these lacquer enamels—or pigmented lacquers, more correctly speaking—offer a genuine relief to the housewife whose family cares prevent the use of varnish or floor enamels because of the "tying up" of the kitchen. If the floor is well mopped with washing soda and water at seven in the evening and dried till time, it can be given a coat of gray floor lacquer for instance, in an hour, allowed to dry overnight and safely used the next morning.

Brushes used in lacquers must be thoroughly cleaned in lacquer thinner or they will become rock hard.

Wax should not be used on lacquered floors, since no method I have yet tried will remove it so thoroughly as to allow the floor to be relacquered without slow drying.



We Studied Years

To correct the mistakes of old-type shaving preparations for you — now please accept a 10-day tube of Palmolive Shaving Cream to try

GENTLEMEN

Palmolive Shaving Cream is a truly unique creation

We made it up to meet the supreme desires of 1000 men whose ideals of a shaving cream we asked

130 formulas were developed and discarded before we found the right one. All our 60 years of soap study, we put into this preparation

Then we told men, "Don't Buy, Yet—accept a 10-day tube to try and find out first if you like it"

The result was a business sensation. Palmolive Shaving Cream rose, almost instantly, to a leading position in its highly competitive field

Millions of men have flocked to it. We think you will find it

superlative in a shaving cream. Hence, seek the opportunity of sending you a 10-day tube to try

These 5 advantages

1. Multiplies itself in lather 250 times
2. Softens the beard in one minute
3. Maintains its creamy fullness for 10 minutes on the face
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Just send coupon

Your present method may suit you well. But still there may be a better one. This test may mean much to you in comfort. Send the coupon before you forget

THE PALMOLIVE-PET COMPANY, CHICAGO, ILL.



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10 SHAVES FREE

and a can of Palmolive After Shaving Tale

Simply insert your name and address and send to: Dr. B. M. Palmolive, Dept. 10, Chicago, Ill.

Be sure to send your address to Palmolive, New York, N.Y.

Please print your name and address

Neat Bookcase Joints

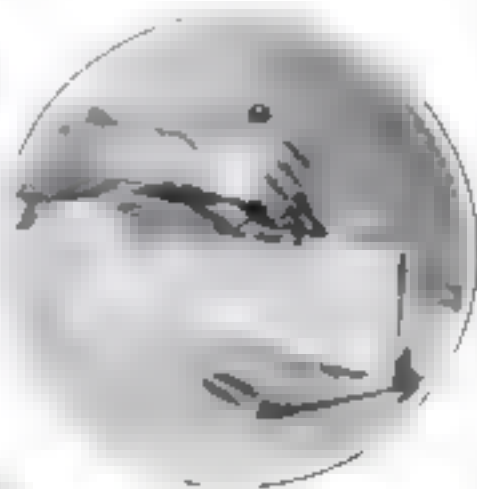
*How to fasten furniture cases together
without using nails or screws—
Dovetail-dado construction*

By EMANUEL E. ERICSON, *Nord Manual Training Authority*



1 Square two lines across the vertical members of case where each shelf is to come, and a third one $\frac{1}{4}$ in. above the lower line in each instance. See 2

2 (Right) Gage on edge for depth of groove (see 7), mark tail or tenon on shelf to correspond, mark angles on both members with a bevel square



3 Left Saw vertically to the gage line where top edge of shelf is to come. This edge of the groove is to remain square. A V cut may be made with a chisel to facilitate starting the saw, if desired



4 Make the angular cut for the groove by holding the back saw at the proper slant



5 Cut out the groove with a chisel that is narrow enough not to mar the edges



6 Saw and chisel the tenon or tail on the shelf or cross member. Be careful not to split off the sharp edge. Some mechanics prefer to use a wide chisel and make the cut from the end of the wood. Work closely to the lines



7 One should be able to slide the tail or tenon into the groove with the pressure of the hands alone. Glue may be used in the final assembly unless the piece of furniture is to be made collapsible for ease in shipment

How can you judge a padlock?
By the name YALE on the
outside which guarantees the
mechanism on the inside.

The Yale & Towne Mfg. Co.
Stamford, Conn., U. S. A.
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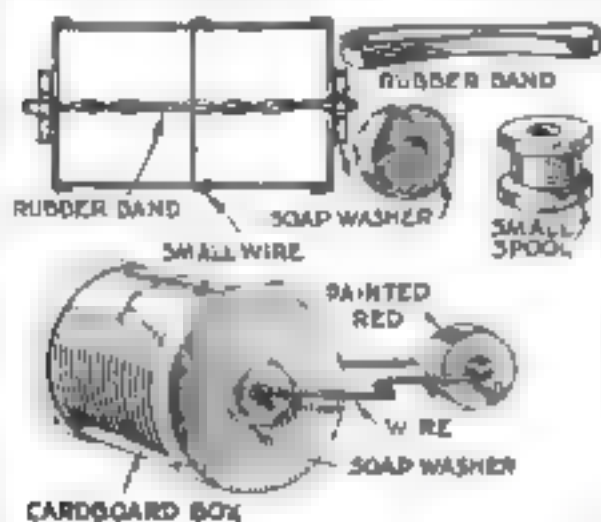
YALE MARKED IS YALE MADE

Rubber Band Tractor Is Amusing Toy

By F. CLARKE HUGHES

THIS month's "conic" is a rubber band tractor, which will please the children because it will run.

The materials needed are a cardboard box $2\frac{1}{4}$ in. or less in diameter, a large rubber band, a stiff wire, two disks of soap or paraffin and a small spool or other round object for the rear roller.



How the tractor is assembled. Two washers made of soap or paraffin regulate its speed.

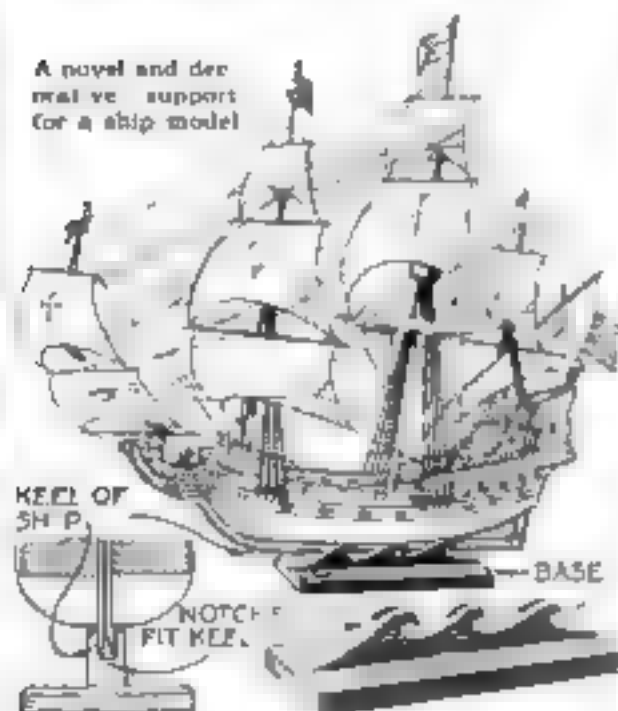
These are assembled as shown. Note that a thin wire, placed crosswise through the box passes between the rubber strands.

The toy will be more attractive when painted in very bright colors.

To wind up the motor, merely turn the cardboard box a few times. With a powerful rubber band the tractor should run 15 or 20 ft., if wound to full strength.

Builds Wavelike Stand for Galleon Model

A novel and decorative support for a ship model.



AFTER building a Spanish galleon from plans published in POPULAR SCIENCE MONTHLY, Floyd E. Freeman of Philadelphia designed the stand illustrated, which differs considerably from those ordinarily used for decorative models. It has the advantage that it does not interrupt the flowing, graceful lines of the hull. The model itself is the ship shown on our Blueprints Nos. 46 and 47 (see page 10).

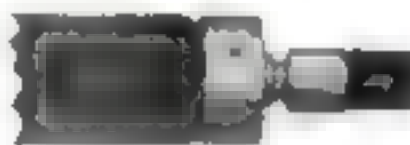
The New No. 11



—a
Brown & Sharpe
Micrometer
with several
exclusive features

BS

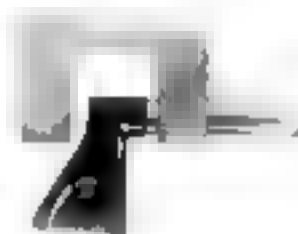
Black Frame Micrometer
Caliper No. 11 • \$6.25
With Ratchet Stop \$6.75



New type of adjustment on the barrel. Positively locked in position after adjusting.



Shape of frame at end and permits measuring around projections, splined shafts or slotted and odd shaped pieces.



Narrow frame makes it possible to use in places where usual style of micrometer will not enter.

A feature of this micrometer is its adjustment for wear. It is so constructed that adjustments do not change the convenient reading position of the graduations on the hub.

The No. 11 has an exceptionally wide range of usefulness. It gets at places other micrometers cannot reach — its new frame design gives it greater measuring capacity.

The frame is of I-section for lightness with strength and rigidity. It has the popular black japanned finish.

Ask your dealer about Micrometer Caliper No. 11, or send for circular. For other Brown & Sharpe Tools, send for Catalog No. 30.

Dept. P. S.

BROWN & SHARPE MFG. CO.
Providence, R. I., U. S. A.

BROWN & SHARPE TOOLS

"World's Standard of Accuracy"

New Fishing Rods for Old

(Continued from page 80)

Get No. 4-0, if you can. Then rub the joints with tissue paper and clean with a few drops of gasoline on a silk cloth.

You can grade your new winding silk with the original silk threads taken from the rod. Keep specimens from the butt section, the middle section and the tip. Any sporting goods store will furnish thread in spools to match these samples.

Some amateurs choose loud and flashy colors, but it is far better to use only two colors in more or less light shades. Green and yellow are excellent.

Many fly rods are still fitted with the so-called ring-and-keeper guides. These I should be inclined to replace at this convenient opportunity with snake guides.

All rod windings terminate with what is known as the "invisible ending." In the diagrams on page 83 are shown two methods of accomplishing this. The beville method is by far the better when making windings of five or six turns such as on the tip section. When the end of the thread has been clipped close, work around the band in one direction with your thumb and forefinger so as to smooth the threads.

When you arrive at the point where the first guide is to be installed, tie down each shoulder temporarily with a couple turns of silk thread; knot and clip off the ends. Then wind over one of the shoulders until it is tucked tight; remove the temporary thread and finish the winding. Fasten the other shoulder similarly (see the diagram on page 83).

WHEN all the windings have been made, pass them swiftly over a flame just close enough to burn off the silk fuzes.

If you should apply varnish directly to the silk bands, their color would change, so apply a coat of thin, high grade white shellac to the windings with a small artist's camel's-hair brush. The shellac can be purchased at sporting goods stores, if ordinary white shellac obtained from a paint store is to be used, be sure to thin it liberally with alcohol. Go around the bands, not up and down. Wipe off the shellac immediately; just enough is needed to wet the silk threads through. Allow the windings to dry from four to ten hours.

The question as to whether the initial coat over the bamboo should be shellac or varnish depends upon the condition of the

rod. If it is new or comparatively new and from good to fair in condition, it does not need a first coat of shellac. If the rod is old, my experience has been that it is wise to shellac it and hang the joints up to dry for not less than a week.

Generally, however, the first coat on the bamboo will be varnish. Many varieties of spar varnishes and coach varnishes are used. A clear brushing lacquer of high quality, if guaranteed by the manufacturer for use outdoors and on sporting equipment, is probably as durable a finish as one could wish at any rate. It has the great advantage of drying quickly.

The varnish used must not be too thick and heavy, a condition met with especially when the weather is cold. Many prefer to apply four or five coats of thin, easy flowing varnish to two or three coats of heavy varnish. The varnish should not be cold, my practice is to place the receptacle holding it in warm water. Heavy varnish may be thinned with a little genuine spirits of turpentine.

C Two wooden plugs to fit into the open ferrules of the butt and middle sections, turn a small screw eye into each, and hang up as shown on page 80.

Use a brush $\frac{3}{8}$ or 1 in. wide, preferably flat, and with bristles not too soft. The entire secret of varnishing a rod is to use as little varnish as possible and to apply that by brushing it well. Never flow the varnish on thickly, as if finishing a table top or floor. Take one tip or joint at a time. When you come to a winding, brush around the threads, rather than across them. Work in a good light. As you reach the guides, varnish under them, working with the tip of a camel's-hair brush under the beginning of the shoulders, which is a vulnerable place for the entrance of water.

Hang the sections in a warm, dustless room and let the first coat dry for a week or ten days. The drying process can be hastened without harm by hanging the sections in the wind, out of doors in a shady spot.

From three to five coats of varnish may be applied, depending upon the consistency of the varnish.

When the last coat is hard, rub the rod lightly with fine powdered pumice stone and water. Wash now and then with cold water to see that (Continued on page 85)

"I'll stick to my Cheney, thanks!"

"You needn't try to palm off any other make of hammer on me. It's a Cheney Hammer for mine—first, last and always."

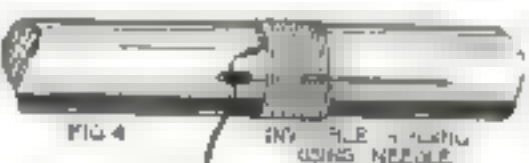
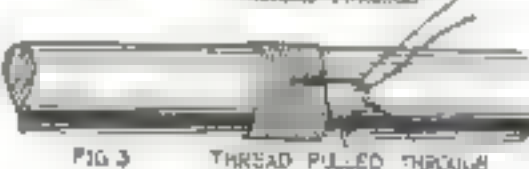
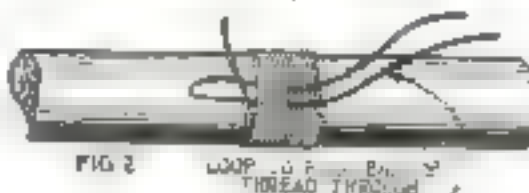
"Nobody can tell me they make a better hammer than the Cheney—and if they do, I'm not interested. A Cheney Hammer suits me from the butt end of its slick hickory handle to the tip ends of its specially tempered claws. I've had a Cheney sticking by me on every job for years and believe me, hammers take some punishment in my work."

"So, I'll still stick to my Cheney, thanks, I like its wonderful 'hang' that's so easy on the wrist. Lots of hammers tire you to death to swing 'em all day—but a Cheney Hammer, never!"



New Rods for Old

(Continued from page 92)



Two ways to end a winding invisibly and method of stretching a snake guide

you are not rubbing through the varnish. As soon as the surface is smooth, dry the sections and go over the whole with dry rottenstone, which will give it a polish. A soft piece of clamshell skin can be used to give a final polish.

It is fact that very few amateurs give their rods this final care and polishing accounts for the fact that their rods are rough rather than beautiful. The polishing completes the refinishing process.

Clamps for Wood-Turning Lathe Save Stooping



How a wooden or iron rocker arm is used to bring the clamping handle above the bed

TO CLAMP the tailstock and tool rest on a wood-turning lathe of the type illustrated, the workman ordinarily must reach underneath the lathe. Adjustments may be made more conveniently if the clamping device is rearranged so that the handle is above the lathe bed. This is accomplished by the addition of a long bolt and a wooden or iron rocker arm.—JONAS J. BYBERG.

STAR HANDY GUIDE for HACK SAW USERS

★ HAND BLADES

Material to be cut	SPECIAL FLEXIBLE			FLEXIBLE BLADES			ALL HARD		
	Length	No. of Teeth	Order No.	Length	No. of Teeth	Order No.	Length	No. of Teeth	Order No.
Large Stock	8"	14	814SF	8"	14	814F	8"	14	814
	9"	14	914SF	9"	14	914F	9"	14	914
	10"	14	1014SF	10"	14	1014F	10"	14	1014
	12"	14	1214SF	12"	14	1214F	12"	14	1214
Ordinary Work or General Use	8"	18	818SF	8"	18	818F	8"	18	818
	9"	18	918SF	9"	18	918F	9"	18	918
	10"	18	1018SF	10"	18	1018F	10"	18	1018
	12"	18	1218SF	12"	18	1218F	12"	18	1218
Pipe, Drill, Plates, etc.	8"	24	824SF	8"	24	824F	8"	24	824
	9"	24	924SF	9"	24	924F	9"	24	924
	10"	24	1024SF	10"	24	1024F	10"	24	1024
	12"	24	1224SF	12"	24	1224F	12"	24	1224
Thin Pipe Light Sheets, etc.	8"	32	832SF	8"	32	832F	8"	32	832
	9"	32	932SF	9"	32	932F	9"	32	932
	10"	32	1032SF	10"	32	1032F	10"	32	1032
	12"	32	1232SF	12"	32	1232F	12"	32	1232

★ POWER BLADES

HEAVY—ALL HARD				LIGHT—ALL HARD			
Length	Gauge	No. of Teeth	Order No.	Length	Gauge	No. of Teeth	Order No.
12"	18	18	1218	12"	21	14	1214
14"	18	18	1418	14"	21	14	1414
16"	18	18	1618	16"	21	14	1614
18"	18	18	1818	18"	21	14	1814

Ordinary Work

Send to-day for this Chart

5 points of the
Clemson Star

1. **EXPERIENCE**—25 years of the nation's experience in the manufacture of hacksaw blades.
2. **EXPERIENCE**—25 years of the nation's experience in the manufacture of hacksaw blades.
3. **EXPERIENCE**—25 years of the nation's experience in the manufacture of hacksaw blades.
4. **EXPERIENCE**—25 years of the nation's experience in the manufacture of hacksaw blades.
5. **EXPERIENCE**—25 years of the nation's experience in the manufacture of hacksaw blades.

Every ST Blade is
branded with the STAR

WHETHER you use power hacksaw blades or hand blades you will find the "Star Handy Guide for Hacksaw Users" invaluable.

Different blades are required for different types of work. Be sure you are using the right type of blade for the work you are doing. Get this chart and hang it up where you can always consult it when buying hacksaw blades.

For 44 years we have concentrated on the efficient and economical production of hacksaw blades on a quality and volume basis. This concentration has resulted in the production of hacksaw blades that eliminate the great waste of production... blades that will do the toughest work.

A 2c stamp on a letter asking for the "Star Handy Guide for Hacksaw Users" may save you \$300... or \$2,000. May we send you the chart? It will be mailed the day your request is received.

FREE:—Let us mail you our large hack saw chart to be placed on your wall for handy reference.



HEADQUARTERS for HACK SAW BLADES
Since 1893
CLEMSON BROTHERS, INC.
MIDDLETOWN, NEW YORK

STAR HACK SAW BLADES



A new floor Overnight

If matters not how badly it is scratched, worn, stained or worn—that unsightly old floor can be hidden forever with a coat of KYANIZE Floor Enamel. Behold overnight, a new, permanently bright, clean looking, spotless floor proof against water, weather, wear—even acid! Won't crack, crumble, chip or peel.

Equally effective on floors of polished wood, or outdoor stone, cement, concrete, wood, or old pattern-worn linoleum. Nine solid colors enable you not only to paint old floors but to decorate them as well in varying patterns.

You can do it too. Send 10c for our book in colors, "The Use of Painted Furniture," and we'll supply name of nearest Kyanize dealers.

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724 Everett Station, Boston, Mass.

\$1.00 Trial Offer

If your dealer does not carry Kyanize Floor Enamel send us his name and ONE DOLLAR and we will forward to you prepaid a full pint can of this master enamel for old floors, including brush to apply it. Mention color you desire—Dark Drab, Light Yellow, Warm Gray, Navy Gray, Dark Yellow, Rich Red, Tile Green, Golden Brown, Mahogany Red.

Simply brush it on!

Kyanize
VARNISHES
ENAMELS
for Floors—Furniture—Woodwork

The SHIPSHAPE HOME

Pointers on Brushing Lacquers

*How to Prepare the Surfaces—The Undercoats—
Straightening Out Rough Spots and Laps*

By BERTON ELLIOT

MRS. ANDREWS, who lives across the street from us, was on the phone.

"I've got a fine idea," she announced, with her usual enthusiasm. "Some of the ladies in our card club have been finishing things with the new brushing lacquers. I guess I started them anyway, it's quite the popular thing now. Some of them have done really nice work—breakfast sets, dressers, and tables, telephone stands, lift tables, door stops, magazine racks, book troughs, candle sticks, book ends, tooth bowls, and everything. Of course, there were some things that didn't turn out just right, and most everybody has some question they would like to have answered."

"Well, next week, the party's at my house," she went on breathlessly. "I thought I'd have it on Saturday afternoon instead of the regular Thursday, and get you to come over after we're through playing bridge. Then those who wanted to could stay for a while and ask you questions."

Four o'clock Saturday afternoon found me in the center of a much interested little group of amateur painters, all eager to receive information.

"Suppose we start there," I suggested, nodding to one of the women at the extreme end of the room, "and go around the room to the right, each asking a question. Now for the first one."

"I lacquered our kitchen table and chairs in jazzy breakfast room color—my first questioner said, "and you never saw a better looking breakfast set, but a spot on the table about the size of a dollar has refused to dry."

"Your trouble is undoubtedly due to oil or grease which was not thoroughly cleaned off," I replied. "A kitchen table is apt to have greasy deposits. Very likely some grease soaked into the wood in this spot, and your sandpapering did not remove it. You should have scrubbed the top vigorously with a good kitchen cleansing powder—about half a cupful to a pail of hot water. The surface then

should have been rinsed with clear water with a little vinegar in the proportions of a part of vinegar to a pail of water. Of course, this would have made it necessary to wait overnight for the table to dry thoroughly. A quicker way to remove the grease in a case like this is to wash the table with denatured alcohol."

Isn't gasoline excellent for removing grease?" asked one of the women.

Gasoline is often used for that purpose. It should be high test gasoline, scrubbed on generously. There is some objection to gasoline for this purpose because it has a tendency to spread the grease in a thin film over a larger surface instead of removing it. In preparing a surface for lacquer, one must be especially cautious and, therefore, the oil or cleaning methods I have mentioned are safer. At the same time, gasoline is commonly used and in most cases, no doubt, it is quite satisfactory.

To return to our kitchen table, since we cannot get the grease off at this late stage, I suggest that you try coating over the spot with white shellac. It will un-

doubtedly seal in the greasy or oily deposits. When thoroughly dry, sandpaper lightly, "feathering" the edges so they will taper up neatly from the old surface. Give the entire top of the table another coat of lacquer, being especially careful to go lightly over the shellacked spot so as not to cut through into the grease again. Now, let us have the next question."

"I lacquered a dresser that had been previously finished and the lacquer seemed to act as a paint and varnish remover. Why was that?"

"There are several things that may have caused this. You see, the solvents used in quick drying lacquers are very powerful. Under certain conditions they will soften a paint or varnish coating and lift it from the surface. If the lacquer is brushed too much, it will pull up the softened undercoatings. It should be flowed" (Continued on page 9.)



When too much brushing has left a rough spot, an application of lacquer thinner usually will straighten out the surface.

Pointers on Lacquer

(Continued from page 84)

on quickly and freely with generous brushfuls. I take it, however, that this was not the fault in your case. What probably caused the trouble were breaks in the surface, which permitted the lacquer solvents to get under the old paint film. If the old finish is chipped off, or if it is checked or alligatored, sometimes it will do this. Of course, the surest way of producing satisfactory results, where a high class job is desired in refinishing, is to remove the old coatings and build up a new finish from the bare wood. The most general practice in amateur painting, however, is to coat over the previous finish. Where there are breaks and abrasions in the surface and there is any doubt about its being suitable for refinishing with lacquer, the application of a coat of shellac, to seal over the surface and fill the abrasions, will, in ninety-nine cases out of a hundred, prevent the lacquer getting under the surface and will generally permit a creditable job. And if it doesn't, it hasn't taken very long to apply, and you can then take off the old finish. To remedy the trouble you have gotten into, sandpaper the surface thoroughly to smooth down the roughness caused by the lifting up of the old coating. Then apply a coat of shellac, or preferably, two coats, sandpapering each coat very lightly, and apply another coat of lacquer. This will fix it up, I am sure. Now I'm ready for the next question."

"I USED brushing lacquer on our floor, and within a few days it began to come off. It was a hardwood floor, and I used clear lacquer."

"There was most likely some foreign substance on the floor which prevented the lacquer from holding tight—undoubtedly grease, dirt or moisture. The presence of any of these will have a tendency to prevent lacquer from drying thoroughly. Floor oil, wax, furniture polish, and dustless mop preparations generally are of a greasy nature, and the safest way in refinishing a floor with lacquer is to wash the surface in one of the ways I mentioned before. It is much more necessary that the surface be free from grease, dirt and moisture (especially grease) when lacquer is to be used than with the old type of paint and varnish materials. Be sure to remember this. Now for the next question."

"I did some lacquering the other day and it seemed to drag under the brush. I had an awful time to prevent showing laps."

"It's plain to see that you are just starting to use brushing lacquer. Some people do have a little trouble of this kind with lacquer before they become accustomed to it, but they soon get the knack of using it. It's really easy when you get the idea. Lacquer must be applied with a full brush and flowed on freely, holding the brush at an angle and not straight and stiff. Don't scrape most of the lacquer off on the edge of the container and don't try to brush it out. If you do, you are bound to have trouble. Try another piece—starting in on the smaller surfaces. (Continued on page 97)



Harnessing The Air Without Sails

Propelled only by curious spinning towers, the rotor ship "Baden-Baden" recently visited America.

Perhaps in the future we shall have fleets of these vessels plying up and down our coasts, "harnessing the air without sails."

The rotor ship is still an experiment—but an experiment of the type that furthers mechanical progress and develops new uses for files.

There will be NICHOLSON Files to meet future filing needs—just as there are NICHOLSON Files for every purpose today—throughout industry and in the home.

These files will continue to be sharp cutting, durable tools—carefully made and rigidly tested—by men whose life work is the production of highest grade files.

If you would like to read an interesting booklet, send for "Files and What They Will Do For You." It's free—on request.

NICHOLSON FILE CO.

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—A File for Every Purpose

Save Hours with this Guaranteed Lacquer

["Rogers" dries hard in 30 minutes.
Just brush it on!]

Everywhere, people are amazed and delighted at the speed and ease with which Rogers Brushing Lacquer works. It is almost magical.

No tedious preparation is needed. "Rogers" goes on right over the old finish. This saves a lot of time. Then it does not require long, expert "brushing out"—because it covers readily and spreads easily. You merely flow it on with a tall brush. This, too, saves time. "Rogers" forms a beautiful, tough colorful film that sticks tightly to any new or old surface. Then, it

Dries while you wait!

Dries in 30 minutes or less. Dries free from lips or brush marks. Dries before dust can soil its brilliant sheen. Dries before damage comes to it. Dries in time for any urgent need. Dries to a smooth, hard, colorful finish that wears and wears and WEARS. Does not "print"—or gather lint.

Think what this will mean at housecleaning time—when you want things done well but quickly.

There are scores of uses for Rogers Brushing Lacquer in your home right now. A few are suggested on the opposite page. Every store, office, factory and building can use it in hundreds of practical ways. Many industries are employing it. Try one can and see for yourself.

Dealers everywhere carry "Rogers." Comes in cans, mixed and ready for use. Your choice of 18 wonderful colors—also black, white and clear. For best results insist upon the genuine in the "Oriental" can. Read our publicly advertised "Money-back" Guaranty to the right.

DETROIT WHITE LEAD WORKS, Detroit, Michigan
Makers of Highest Grade Paints, Varnishes, Colors, Lacquers

ROGERS

BRUSHING

LACQUER



Our "Money-Back" Guaranty

Try one can of Rogers Brushing Lacquer. If not more than satisfied, return what is left to your dealer. He is authorized to refund the entire purchase price.

Also distributed and guaranteed by

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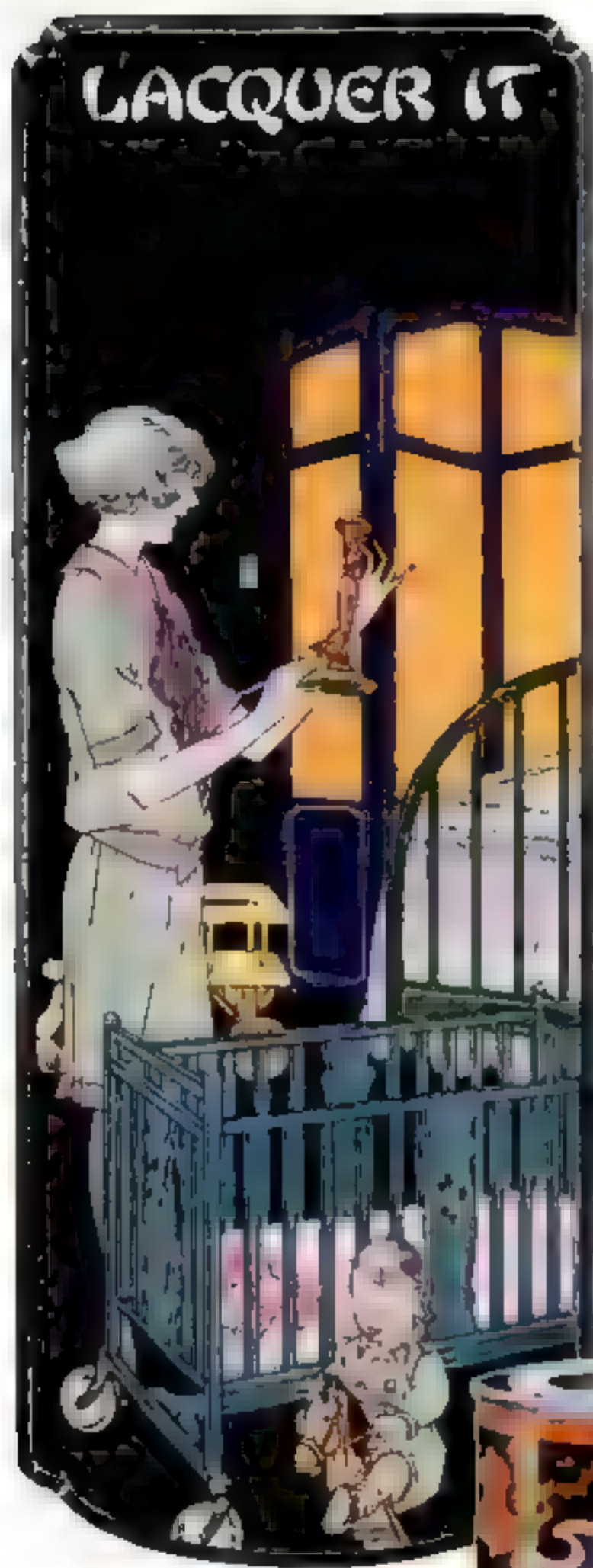
LOWE'S PAINT AND COLOR COMPANY
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IT DRIES WHILE YOU WAIT



LACQUER IT



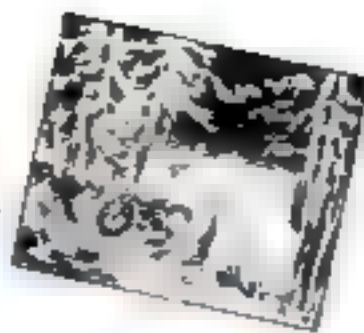
DRY-30 MINUTES



DRIES SWIFTLY OUTWaits

for Sport, Health, Economy!

Vacation



Trip in the Country



Running Errands



VACATION trips, the very ones you have promised to take "some day"—glorious week-end tours over back-country routes—you can afford them all with a Harley-Davidson!

Happy, carefree miles over winding rural roads, with the fresh country breeze in your face—that's motorcycling, the sport of a thousand joys!

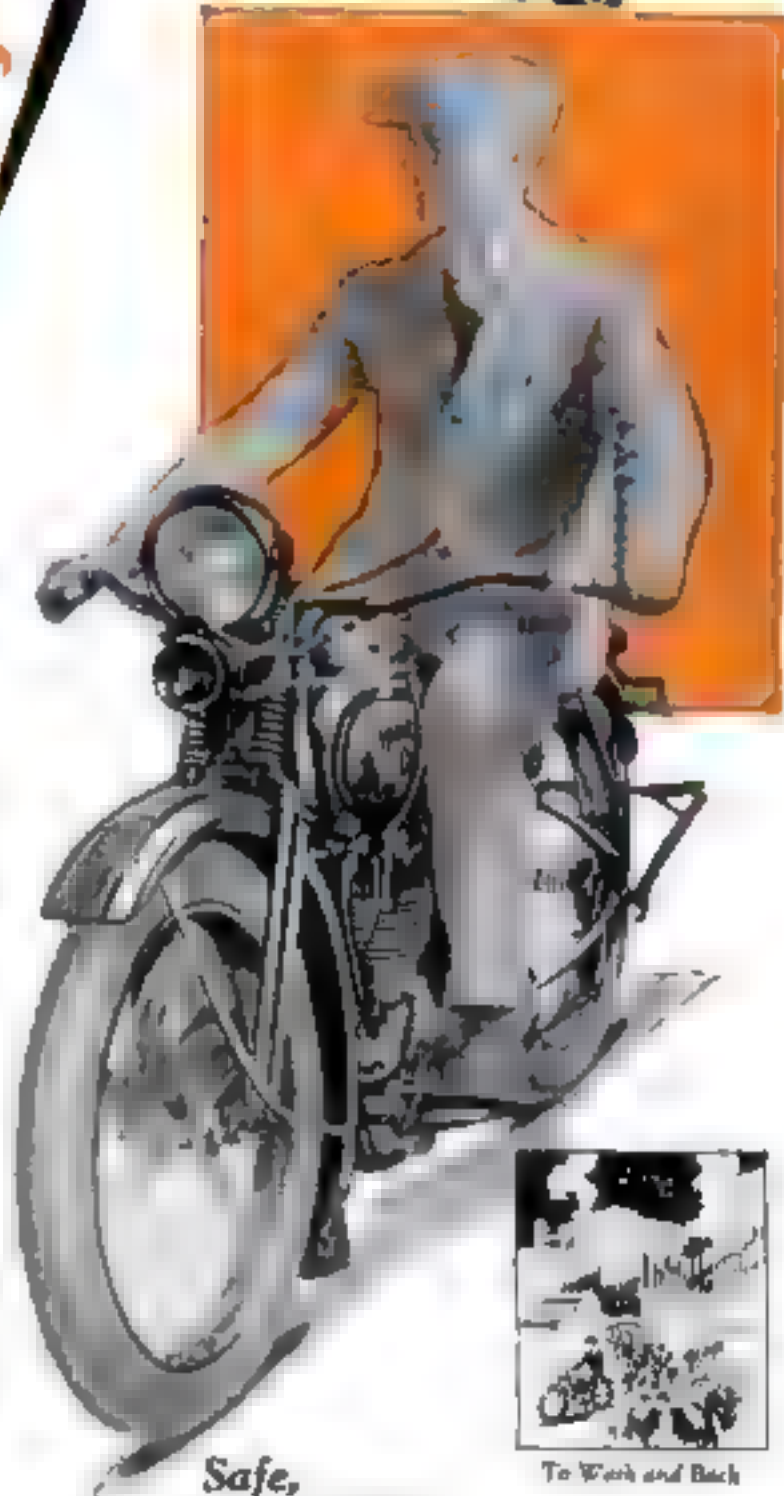
It all costs only *one cent per mile* with a Harley-Davidson Single. This new-type motorcycle travels 80 miles per gallon, and is safe and dependable. Any 2 x 8 foot space will park or house it.

Easy to buy, too. Ask your Harley-Davidson Dealer about his Pay-As-You-Ride Plan. Price, complete with 3-speed transmission and full electric equipment, f. o. b. factory, . . . \$235

Mail Coupon for Literature.

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Department PS Milwaukee, Wisconsin

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HARLEY-DAVIDSON
[*New-Type*] *Single*
Motorcycle



*Safe,
Comfortable,
Easy to Ride!*



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HARLEY DAVIDSON MOTOR COMPANY
Department PS, Milwaukee, Wisconsin

- ☐ Interested in Single: send catalog.
☐ Interested in low-cost delivery service.

Name

Address



Pointers on Lacquer

(Continued from page 85)

such as chair rounds and legs. If you still have trouble, it may be the brush. A soft bristle brush, such as sitch or bear hair, should be used."

"THAT reminds me of some trouble I had," said one of the women. "I've done quite a lot of lacquering, and as a rule I don't have a bit of trouble, but the other day I was doing a chair and was interrupted when I was working on the top panel. Before I knew it, the material had set up a little, and I roughened it up into quite a 'mess.' I couldn't get it smoothed out. There must be some way of fixing it."

"So there is," I assured her, "although surprisingly few know it. Always have an open can of 'thinner' near by. If you run into anything of this kind, dip the brush in the thinner at once and mop it quickly over the spoiled place. Brush it enough to straighten out the surface, then leave it alone. The thinner will melt the lacquer, as it were, so that it will usually flow out again and level itself without showing brush marks."

And here the discussion ended, for no one could think of more lacquer problems.

If you have questions about brushing lacquer not touched upon by Mr. Elliot, he will be glad to answer them by mail. Please inclose a self-addressed and stamped envelope.

"Dustless" Door Mat

UPON returning from the garage or cellar workshop, one is apt to leave footprints of concrete dust upon waxed or polished floors. Wiping the feet hastily upon a mat at the door will not always remove the white dust. If, however, the



If treated with a little oil, a cellar door mat will take up concrete dust more readily.

mat is impregnated with a teaspoon of light machine oil in a pint of gasoline, the very act of walking over it will be sufficient to dust clean the soles of one's shoes. This small amount of oil in a mat will not cause oily marks to be left upon rugs or carpets.—R. WAILES.

BEFORE applying white enamel, fill nail holes in the woodwork or plaster with putty made by thickening flat wall paint or enamel undercoat with cornstarch or whiting. This will not discolor the enamel later as common putty, made with linseed oil, is apt to do.



For that clean-cut look of success

try this invigorating massage after shaving

SUCCESSFUL men look the part. They are clean shaven, clean cut, and well groomed. They have that glowing look of health and vitality.

A muddy, half clean, blackhead-dotted skin can never be a partner of the successful man. Yet you can have the clean look of success. It takes no extra time. It can be acquired easily and pleasantly in your own home.

After you shave, use Pompeian Massage Cream. You usually use something after shaving—hot towel, lotion or cream—to remove the

dirt and clinging soap particles that become imbedded in the skin. Water, lotions, soaps—all reach the surface only. They do not remove imbedded dirt and secretions Pompeian Massage Cream does.

Use this pleasant, gentle cream after shaving. See how your skin takes on the glow of life and action. See how imbedded dirt, even blackheads, rolls out under the mild but efficient urge of this quickly applied massage. You will like its restful, zestful "feel." Above all, you will like it for the feeling it gives you that—by gosh! you really are clean.

Make this convincing hand test first! Wash your hands thoroughly. Rub a little Pompeian Massage Cream over the back of your hand until the cream has disappeared, then comes out again. Notice this—the cream goes in pink and comes out black. The black



is dirt that you could not remove by washing. You can make this simple but convincing test today. Get a jar of Pompeian Massage Cream in any drug store for sixty cents. If you prefer to make the test before you buy, merely mail the coupon below.

POMPEIAN MASSAGE CREAM

Increases Your Face Value

FREE - TO MEN ONLY

The Pompeian Company, Dept. 31A, Cleveland, Ohio, please send me first, the sample tube of Pompeian Massage Cream, with enough coupon to make the hand test, and to give me several massages.

Name _____

Street _____

City _____ State _____

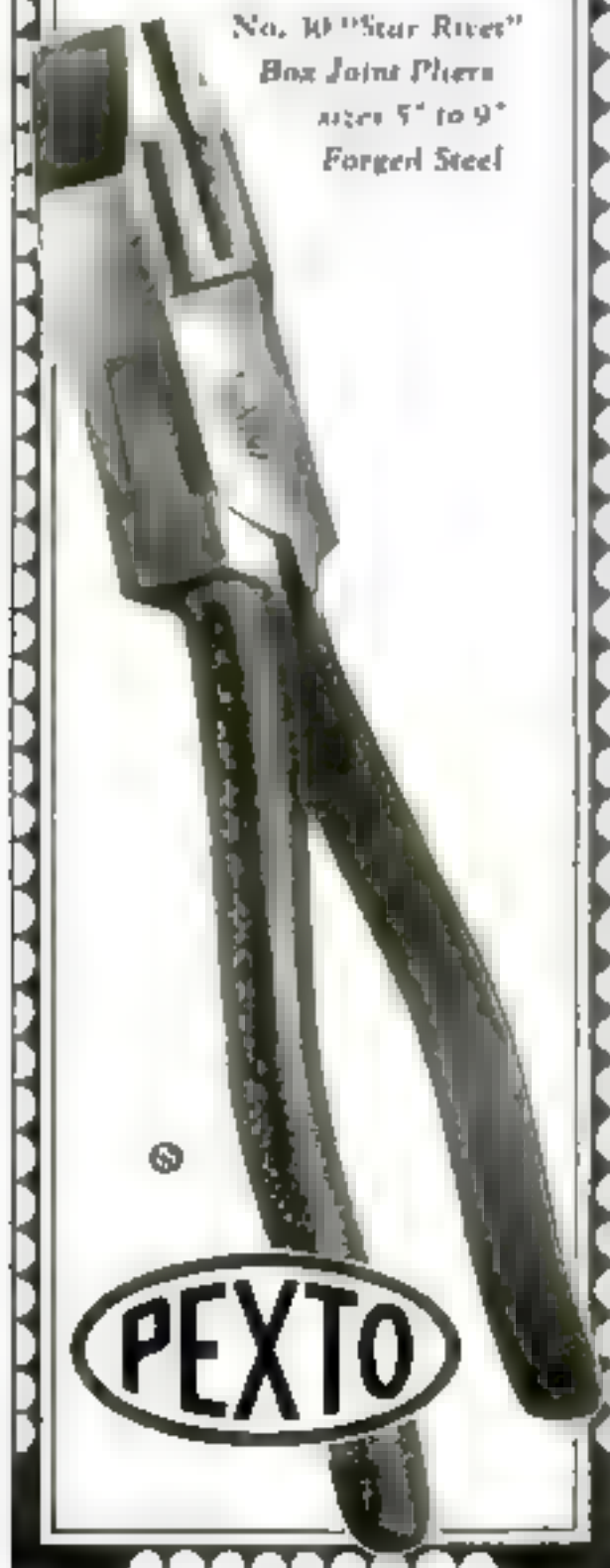
Worth While TOOLS

The kind of tools used often determines the quality of the work. To be sure of the best results, get the right tool for the purpose. There's a large variety of PEXTO Tools made in all practical styles and sizes. You can't go wrong if you insist on these century-famous tools.

Write us for Booklet

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WILCOX COMPANY**
Southington, Conn., U.S.A.

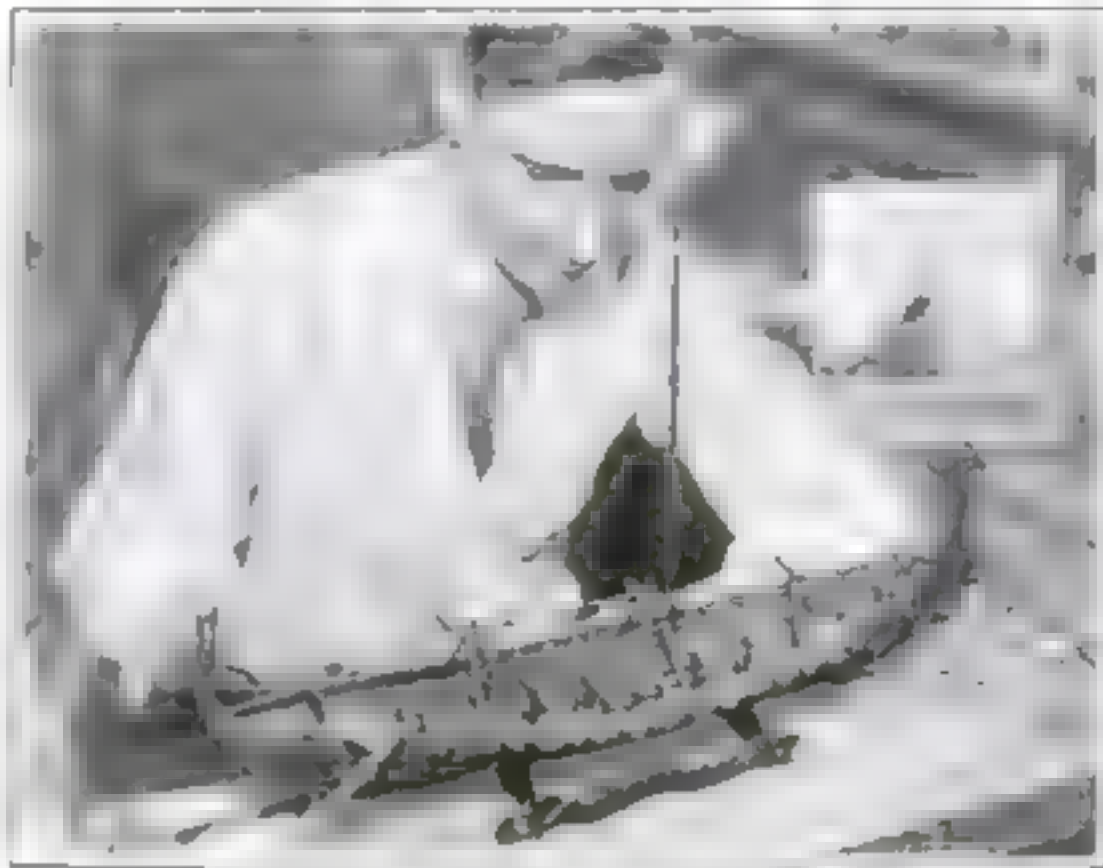
No. 10 "Star River"
Box Joint Pliers
sizes 5" to 9"
Forged Steel



You Can Build a Viking Ship

*Our Blueprints Will Assure Your Success in
Making a Highly Picturesque Model*

By CAPT. E. ARMITAGE McCANN



Captain McCann at work on the latest Popular Science Monthly ship model. Full size drawings of the ship are contained in Blueprints 61 and 62 (see page 101)

OLAF TRYGGVASON's long serpent had thirty oars a side, one of Canada the Great's ships had sixty. The Viking ship model we are hereing is a sextensesse, with sixteen a side, which means that her prototype had sixty four rowers and a crew of from seventy to eighty.

Those who would like to build this model of a Viking ship but have not read the two previous articles in April and May can obtain full size drawings of all the parts and a complete list of materials by sending for Home Workshop Blueprints Nos. 61 and 62 (see page 101).

The mast step (page 99) may be made next. The base block is notched underneath to take three frames. The mast steps in a square hole $\frac{3}{4}$ in. deep, located $1\frac{1}{4}$ in. from the forward end. Use a piece of straight grained pine or a $\frac{3}{4}$ in. dowel stick 12 in. long for the mast. Taper it to about one third less at the upper end.

Slip the mast rod on the aft side of it, erect a post $\frac{1}{4}$ in. square. Next make two side clunks or partners $\frac{1}{4}$ by $\frac{1}{4}$ by 2 in., and cut notches in them about $\frac{1}{8}$ in. square to receive the wedge that holds the mast upright. Glue and pin the step block fast along the center of the keelson.

To fasten a post and beam or other light parts together, bore nearly through them and press in the pin with the pliers as shown on page 90, May issue. Cut off

the end and crimp it. In practice the writer has found it as valuable as any possible to use nails, pins or pegs. To aid the glue as a model has to stand rough usage and many on slaughts of the feather duster.

On the outer deck place the stern board (page 90). Then we may as well make the chocks for the steering oar. Both are of semi-hardwood. The upper is $\frac{3}{4}$ by $\frac{3}{4}$ in. It is glued and nailed outside to the gunwale on the starboard side with its center about $\frac{3}{4}$

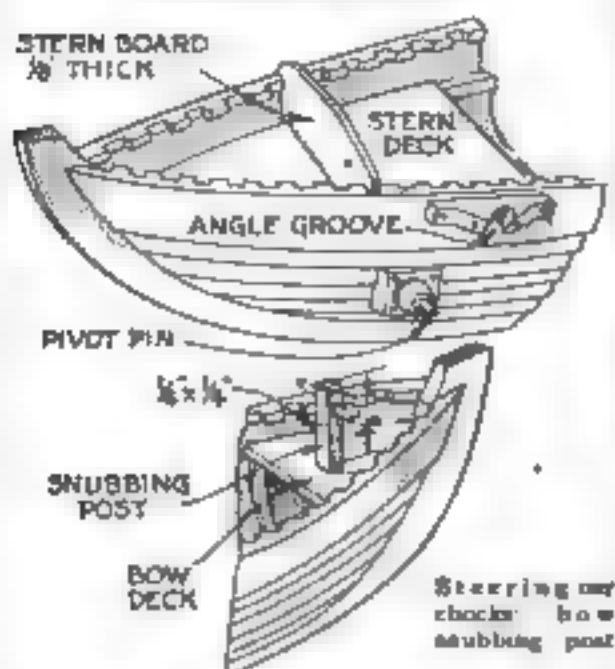
(Continued on page 99)



Stern of the famous Oseberg ship, which was dug up in a remarkable state of preservation

A Viking Ship Model

(Continued from page 88)



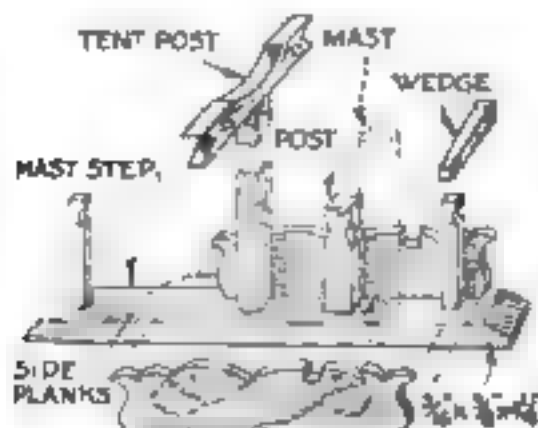
in, abaft the front edge of the after deck. From the plank on which the helmsman stood or "steerboard" side, comes our modern name of "starboard" for the right-hand side of a vessel. The other was the "larboard" or "larboard" side, meaning the empty side; this word larboard was later changed to port, to save confusion. 'Port' is from the Portuguese, meaning the open side, which was laid next to the quay.

The lower chock is like a cone on a board. Take a piece $\frac{3}{8}$ by $\frac{1}{2}$ by $\frac{3}{4}$ in., cut one flat side to fit on the planking $\frac{3}{4}$ in. (center to center) below the upper chock and $\frac{1}{2}$ in. abaft it, and through the center bore a slanting hole $\frac{3}{8}$ in. in diameter. This hole is at a right angle with the keel and horizontal when the block is in position. With the outside end of the hole as a center, whittle the block to the shape of a cone with flat ends, and glue and nail in position.

From the middle of the forward deck there projects a post for the anchor cable, as shown above.

The supplementary carvings for the head and tail of the dragon may now be made. First saw two outlines as shown on page 100 and full size on Blueprint No. 61. Note that the outline differs from that of the centerpiece. With a knife or other tools, carve them to make prominent the ears and the mane, cut in the center of the ears and the eye sockets; cut the teeth back a bit from the edge of the lips, and run an incised line to mark the outside of the lips.

For eyes, I glued in rubies from a notion counter. (Continued on page 100)



Mast step with one side plank moved out of place to show the construction.



Now!

New Indian Scout 45

The Police Special and Sport Solo

Now for the fun! Now for the thrills! Now for the big 'kick' of outdoor sport at its best! Here it is—the new Scout 45—inviting you out to a real world of adventure!

The Scout 45 has a super-powerful motor, snappy acceleration, large oversize brake, classy sport handle bars. Holds boundless power for the veteran rider, easy handling features for the novice. Takes you anywhere—any time—and brings you back safely. Ride the 45 a mile—and see what a champion sport solo it really is.

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Indian Motorcycle Co., Dept. H-6, Springfield, Mass. Send me FREE descriptive circular on the new Indian Scout 45. This places me under no obligation.

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Make big money from repair work

\$10

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\$50

Practically every household spends at least \$10.00 to \$50.00 each year and many spend several times that much on simple repairs that can be made quickly, easily and well with

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Toy "Sub" Dives and Rises

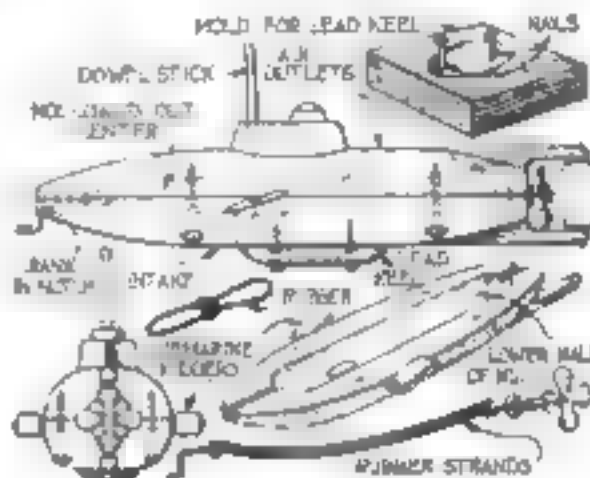
By H. SIBLEY

THIS bathtub submarine, properly balanced, will perform amazing feats. When released on the surface with planes set for submerging, it starts under with a whirr and gurgle and a stream of bubbles from the air outlet back of the conning tower marks its course. It will turn in a limited space and will come up gradually after the speed slows down.

Any easily worked wood may be used. The ballast can be melted from scrap lead. Have the mold large enough so that the keel can be filed down until the "sees" water line is just over the propeller when floating idle. Make the galvanized sheet iron propeller as large in diameter as the rudder supports permit.

The rudder and elevating planes will swell on their axes and be tight enough to maintain any position in which they are set.

Paint the boat slate gray and apply several coats of spar varnish. Bright varnish will set off the propeller to advantage, and a row of brass-headed-up hol-tery lugs will



How the "sub" is made. The hull proper is 10 in. long, 2½ in. wide and 1 in. deep



The toy submerges like a real submarine and when the motor runs down comes up

give the appearance of rivets.

It goes without saying that the little submersible can be made in various sizes. Lightness is not a requisite; in fact, a heavy wood would be preferable. If a larger boat is built, the motor can be made with heavy rubber bands such as are sold for model airplanes.

You Can Build a Viking Ship

(Continued from page 89)



To complete the dragon's head, two fret sawed and carved pieces have to be added

hmooh. This is very effective, but red beads or pinheads painted red will serve.

The dragon's or serpent's head was made as fearsome as possible to frighten the enemy and had eyes so that the ship could see to keep out of danger, as with Chinese boats to this day.

The tail is the natural complement to the head. Two small sidepieces are cut to the shape given on the blueprints and carved with a flowing tail effect.

All four pieces are glued to the center-piece and clamped until firm.

The hull is now ready for coloring. I

gave all of what we have so far made, with the exception of the long posts, a coat of rather dark oak stain—a little darker outside than inside. I then took some black stain and painted all the outside of the centerpiece, including the head and tail carvings. The outside of the gunwales and the mast step. When the stain was dry, I rubbed the hull dry and very lightly with some fine steel wool to remove a little of the stain from the edges of the planks, thus emphasizing them.

Everything was then given a thin coat of shellac varnish. The long posts of brown wood were varnished only.

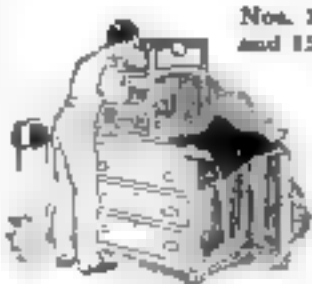
The tongue is bright red; inside the ears and along the jaw, a duller red. The teeth are gilded, as are the edges of the ears, mane and eyebrows. At the tail the carved plumes are gilt. The scroll work along the stem, stern and keel, to be described later, will also be gilt. This gold work should be reasonably bright, but not too glaring.

Next month we shall make the rest of the small parts, the sails and the base, and finish the decorating.

To make a light gray-green stingle stain, mix one part pure boiled linseed oil, one part flitting oil and one part creosote. Add a little white lead to give it body and tint with chrom-um oxide, toned down with a very little lampblack.

Blueprints for Your Home Workshop

ANYONE of the blueprints listed below can be obtained for 25 cents. The blueprints are complete in themselves, but if you wish the corresponding back issue of the magazine, in which the project was described in detail, it can be had for 25 cents additional so long as copies are available. The Editor will be glad to answer any specific questions relative to tools, material, or equipment.



Nov. 7
and 15

POPULAR SCIENCE MONTHLY
250 Fourth Avenue, New York

GENTLEMEN:

Send me the blueprint, or blueprints, I have underlined below, for which I inclose.....dollars.....cents.

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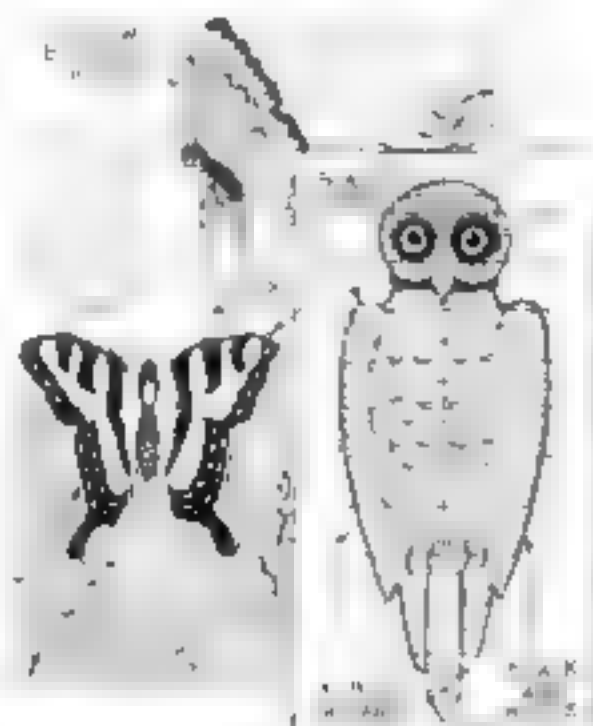


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FREE
Target
and
Game
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Fret-Sawed Plant Sticks Enliven a Garden



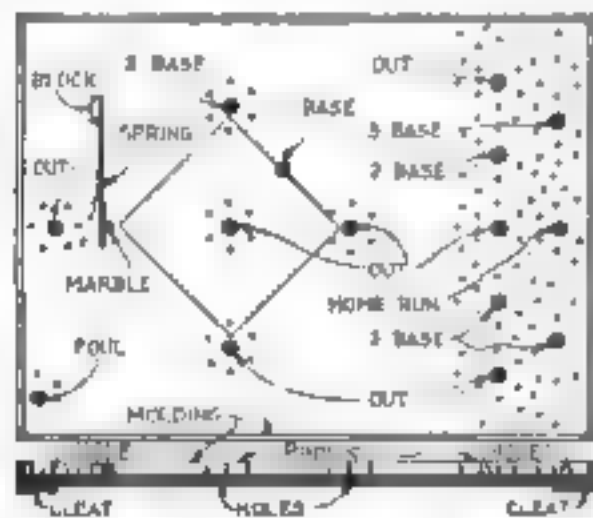
Three designs for plant sticks. The butter flies are 7 or 8 in. long, and the part, 10 in.

THESE plant sticks are excellent projects for those who find pleasure in simple woodwork. They are made with a coping saw, painted in bright enamel colors, and mounted on sticks $3\frac{1}{2}$ in. square and about 30 in. long, or long enough to bring them in their natural relation to the foliage.

The wood should not be more than $\frac{1}{8}$ in. thick. When the forms have been cut out, it is well to give them and the sticks a coat of white lead and oil before coloring them. The sticks may be painted green or brown.—C. A. K.

Early Made Baseball Game for Young Children

A BASEBALL game for amusing small children can be made as shown below. A baseball diamond is laid out on a piece of wallboard 3 by 4 ft. (or smaller).



Top view and section through the board
The splines around each hole are seals

and holes slightly larger than the marble to be used are bored in the positions indicated. This is glued on a foundation made of wood or wallboard. Then 1 1/4-in. wire brads are driven in where shown, and a spring arranged to "bat" the marble. The result of each "hit" is decided by the hole in which the marble rolls.—W. J. EMMONS, JR.

LIFE IS NOT WORTH LIVING
— *Without Sound Nerves*



PAUL VON BOETMANN
 Author of *North Sea and the English*
 of the books on English the English
 of the English the English the English
 of the English the English the English
 of the English the English the English

YOUR nerves govern your life — your efficiency, your happiness, your health. If your nerves are depleted, you cannot concentrate or think clearly; you have not the "pep" and spirit to enjoy your pleasures and sports; you have not the physical comfort and well-being without which happiness is impossible. Is life worth living under these conditions? No! You merely exist — you are not getting out of life *everything* that it has to offer?

We are living in an age of SPEED; we are leading a "mile-a-minute" life. We crowd two, or even for years of life into a single year! We hurry, we worry, and often, we dissipate our vital forces through nervousness. We cannot do this because we are living in an age of acute competition, tremendously high cost of living renders pleasures and things that compel us to strain our nerves to the utmost.

Yet, we go on living our lives hard and fast, little realizing that we cannot go on for long, that there must come an end to our stock of Nerve Force, and that Nerve Exhaustion is staring us in the face!

Every victim of Nerve Exhaustion, when he is stricken with this terrible malady, tends to believe that he has been stricken suddenly. This is not true. The cause, too, has been years developing, and that he has had many, many warnings of what was coming—but he did not heed them. Though he passes through years of sub-normal nerve supply, he pays no attention, he believes it quite common—as many must feel people do—to feel tired and worn out, to suffer sleepless nights in periods, to feel discomfort after meals; to feel depressed, nervous, irritable, and often in a morbid fog. He may say truthfully, "I feel like a worn-out machine," and he will not heed it. He will not heed it until his physician assures him that there is "nothing physically wrong." But as his organs are perfect, that he has no need for rest, and he will be "driven."

A little rest helps a little—for a while, and then he is right back where he started, leading the same old life. Finally he loses us a big, handsome, white, fat, every man's enemy, and all we can do is to keep going while the going is still good. It is not because we every day by its undermining, his cross-country, passing the word, and other physical and mental disorder, and going through its only HALF LIVE!

The country is teeming with cases that fit this story like a glove, for we Americans are the most nervous nation under the sun, not harring even the hot-headed Latins. They may be called "near-neurasthenics." A near-neurasthenic is but a next-door-neighbor to a full fledged neurasthenic in the grip of actual, terrible and complete Nerve Exhaustion—Nerve Bankruptcy!

There is but one malady more terrible than Nerve Exhaustion, and that is its kin, Insanity. Only those who have passed through a siege of Nerve Exhaustion can understand the true meaning of this statement. It is HELL, no other word can

express it. At first the victim is afraid he will die, and as it grips him deeper he is afraid he will not die so great a mental torture. He becomes panic-stricken and irresolute. A sickening sensation of weakness and heart-sickness overcomes him. He becomes disoriented with the thought of self-destruction.

The symptoms of Nerve Exhaustion vary according to individual characteristics, but the development is usually as follows: First stage—lack of energy and endurance; that tired feeling. Second stage—nervousness, restlessness, sleeplessness, irritability, loss of hair, nervous indigestion, sour stomach, gas in

toward constipation, irregular heart power, memory, lack of mental endurance, distention, headache, backache, nervous thrombosis, and other points. The stage serious mental disturbances, fear, undue worry, melancholia, nervous, organic disturbances, sexual frequency, and, in extreme cases, insanity.

If only a few of the symptoms mentioned apply to you, especially those indicating mental turmoil, you may be sure that your nerves are at fault—that you have exhausted your Nerve Force.

Perhaps you have chased from doctor to doctor seeking relief for a mysterious "something the matter with you." Each doctor tells you that there is nothing the matter with you, that every organ is perfect. But you know there is something the matter. Your doctor may prescribe a drug—a nerve stimulant or sedative. Leave nerve tonics alone. It is like making a tired horse run by towing him behind an automobile.

And don't be deceived into believing that some magic system of physical exercise can destroy the nerves. It may develop your muscle but it does so at the expense of the nerves. As thousands of us have learned through bitter experience.

I have for more than twenty years been suffering from a severe form of neuritis, and I have seen many others who have been afflicted with the same disease. I have seen many of the organic and mental disturbances that originate in nerve disease.

Over a million copies of my book "Nerve Force" have been read by people with high strung nerves who have learned through my advice how to avoid nerve strain and how to care for their nerves. The book is a key to a new way of living.

Address: Paul von Beckmann, Studio 1410X, 1033 Broadway, New York City

Order Nerve Force today. It is not a pamphlet or a cheap dry course but a real book, 64 pages, and The Nerve Force is a book of Nerve Force contains important information heretofore limited to private pupils only. Nerve Force is one of the many books which and a Medicine Book at Washington. The book shows their recovery from nerve exhaustion to reading at work. Your money refunded if the book is not as advertised.

A physician writes as follows: "I am writing you as a Graduate M.D. to say that I have carefully read your e-book on Nerve. It has done me more good than all the other things I have read. I feel that I shall be passing on a hundred times what I paid for it. It is impossible to read it without feeling the wonderful Truths it reveals."

[illegible]

Play Arbor Keeps Boys Happily Busy

Has Work Bench, Tool Chest, and Tank for Toy Boats

By H. SIBLEY

MOTHERS' problem is to keep the children interested outside the house; father's is to keep the yard looking something more like residence property than a junk yard. And the problem is complicated if one lives in an apartment or bungalow court, where the back yard, if any, is very restricted, especially as boys will be boys, including the neighbors.

The arbor playhouse illustrated is a simple but very effective solution. The most attractive playhouse ever built, by itself, will not keep boys interested all the time, but by the addition of a work bench, toy chest with lock, and a boat tank you will find the value in it a great part of their time. Over time they will be occupied in wholesome recreation.

This particular playhouse has the double advantage of being inexpensive to build and serving as a home for all the toys and accumulation of odds and ends that otherwise would litter up the yard and fill closets.

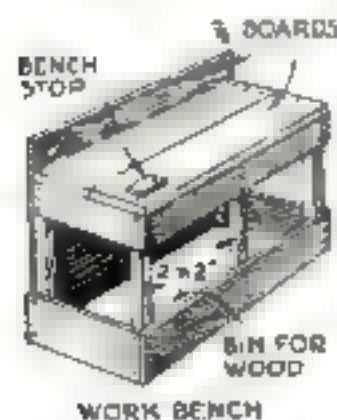
Most important of course is the tank, for it is an old child under ten who is not fascinated by playing with boats, particularly with those crude but beloved craft of his own construction.

FOR the arbor itself all that is required are six pieces 2 by 2 in. by 8 ft. and ten pieces 1 by 2 in. by 8 ft. One of the latter is cut up into diagonal braces for the corners.

A floor is not absolutely necessary, but is worth more than the added expense, as some water will be slopped out of the boat tank. In the original of this design the floor was made up of odds and ends of boards picked up in a vacant lot. This served the double purpose of clearing up the lot and providing free floor material.

The boat tank, which is simplicity itself, will keep the children interested for hours at a time. Any size or shape can be made in this type of construction. It is well, however, to have it 3 or 4 ft. long, or even longer, to give a fair run for the self-propelled boats.

During the hot weather the boys can actually get into the tank and splash around without damaging it. However, it is purposely built up from the ground to make it more difficult for the children to get

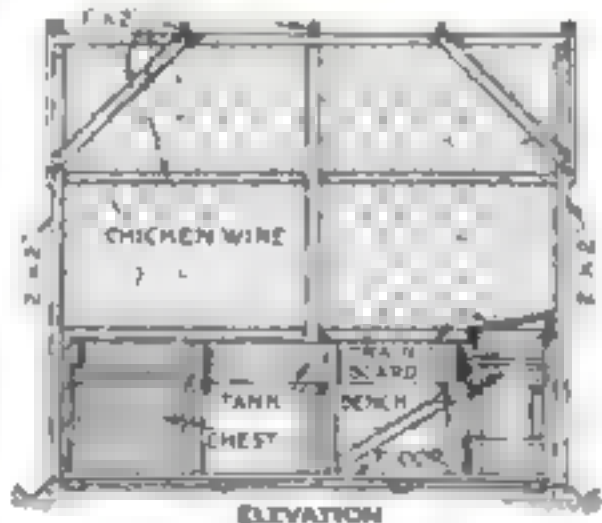


WORK BENCH

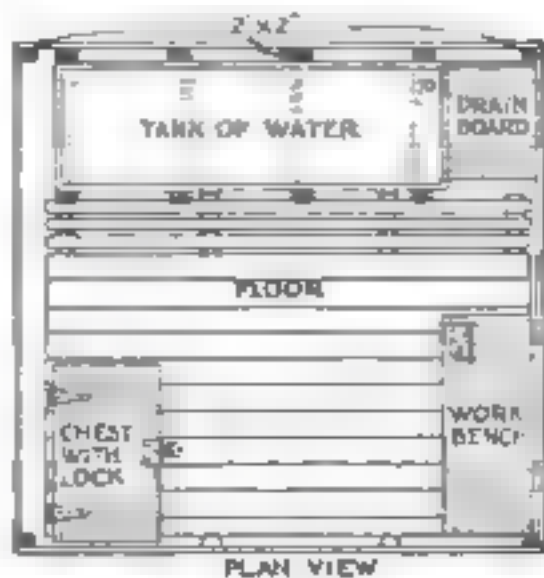
A simple way to construct the work bench



A general view of the arbor and the boat tank which has borne a hundred ships on their shrouded masts



ELEVATION



PLAN VIEW

Typical elevation and plan. Both arrangement and dimensions may be modified

in it and to kick dirt into it.

On account of the accumulation of debris in the tank—paper, sticks, even mud—there should be a drain hole an inch or two in diameter to carry off the dirty water. In California, where the original arbor was built, we utilized this water during the dry summer season for irrigating the plants and vines, with astonishing results. Back to earth has its particular variety of fast-growing plants here we placed morning glories on the east, and Japanese honeysuckle on the west and north. These completely covered the frame, they were set out between the

and irrigation ditch. On the outside a row of pear trees and was planted. All were chosen for fast growing as the arbor was built on a vacant lot and, therefore, temporary. In some locations, grapes, honey-suckle could be used as a covering.

IF NO lot is available large enough to bore a 1½ or 2 in. hole, mark a circle and drill smaller holes around this, then connect the holes with a chisel and run with a jackknife. Make a tapered wooden plug, wrap a piece of coarse sandpaper around the taper and rotate in hole until the latter is smooth. This is the same principle as seating a valve in a gas engine motor.

Redwood was used in the original tank, but any clear lumber will do. The beveled edges of the bottom and side pieces as well as the end pieces, permit the hot tar to fill the joints nicely. A drain board set at one end will serve to hold the boats when not in use.

The toy chest can be any large box. The cover is made waterproof with roofing paper or other material and fitted with hinges and a padlock latch.

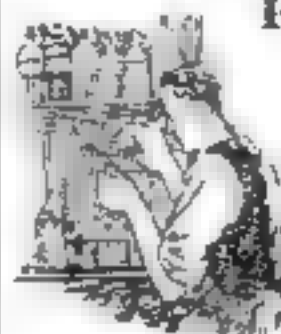
The space underneath the work bench will hold odds and ends of boards to be drawn upon when needed for the construction of new vessels and toys.

To make sure that too much litter would not accumulate around the workshop, an incinerator was built near by. This is simply an old wash boiler with the bottom knocked out, around which is banked an adobe wall. There is an ash pit door on one side.

It is nothing less than astonishing how much work has been done in this arbor. The boys have built toy transportation units for traveling by air, water and land.



How the wooden boat tank is put together



Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

SHELLAC can be purified to such an extent that it makes a perfectly clear solution in alcohol. It then becomes much more valuable to the home worker than the common commercial grades of shellac. It can be used for protecting pictures and other delicately marked or colored surfaces; it also can be used as a finishing varnish on woodwork with the great advantage that it will not turn white in spots as ordinary shellac is apt to do when affected by moisture.

One ounce of flake shellac usually contains about 6 percent wax, 4 percent pigment, and 9 percent sand, wood fibers and other impurities. To remove these, dissolve 2 tablespoons of sodium carbonate in 2 qts. boiling water and add 6 heaping tablespoons of flake shellac. Cool the solution. The wax and other impurities will float upon the surface in a solidified mass, which may be removed by filtration.

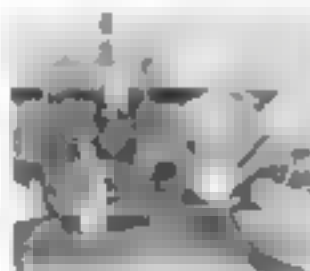
Carefully aerify the solution by adding slowly a few drops of hydrochloric acid while constantly stirring the liquid. This operation must be carried on in a glass or porcelain vessel. The granular light brown or yellow precipitate is collected on a filter and is melted in boiling water to remove excess water and to leave the shellac harder.

A good varnish is prepared by dissolving 3 oz. of the purified shellac in 1 pt. of denatured alcohol. Should the solution still be milky, the shellac probably has been adulterated with rosin and is not suitable for fine work.

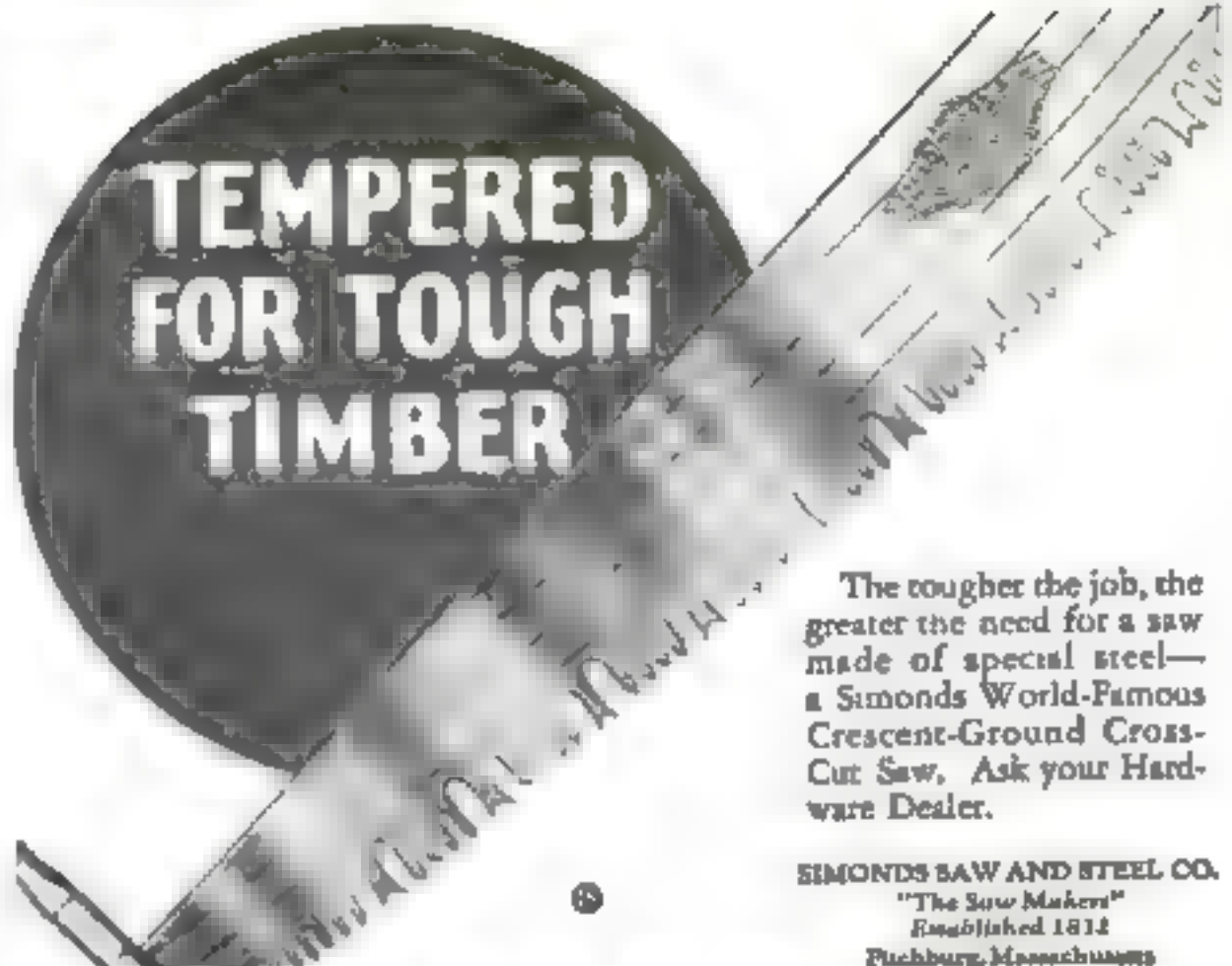
Shellac is an excellent liquid filler for close grained woods, but it will not fill the grain of coarse woods. It can be colored by the addition of alcohol soluble dyes or concentrated alcohol stains; these should be added to the alcohol before the shellac has been dissolved in it.

A floor varnish may be made by using thick turpentine (Venice turpentine) or ozonized turpentine (two parts of the latter or one of the former) with twice its weight of shellac dissolved in 10 parts (by weight) of alcohol. This varnish is more flexible and, therefore, of greater durability than shellac and alcohol alone, but it must always be remembered that shellac is quite soft compared with some of the other varnish gums.

Varnished and shellacked furniture ordinarily should not be touched by water, although a moist and slightly soapy cloth may be used to clean the surface of badly soiled. Otherwise a few drops of furniture polish or light lubricating oil on a cloth will revive the finish.



Preparing a filter to strain shellac



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YOUR Hardware Store can show you these new "Silver Steel" Hack Saw Blades displayed as shown below, for every metal cutting use. No need to waste time, material and labor cutting metal. Look for the ATKINS name on the blade. We will gladly send you descriptive folders of "Silver Steel" Hand Hack Saw Blades.

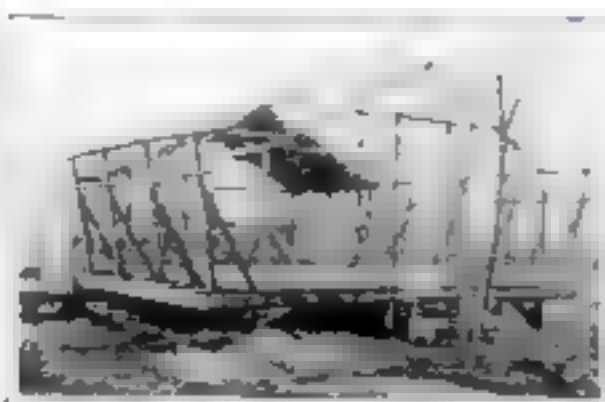
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How to Build a Canvas Camp

(Continued from page 73)



How the platform and framework look before the canvas sections are put in place.

may be inserted where desired after the sections have been sewed.

Brass grommets are placed where the guy ropes are to be fastened. These are inserted on the edge with a punch and die that can be obtained at any well stocked hardware store.

If a shower bath is desired, it can be constructed as shown below and covered with wood, or with boarding or roofing paper. The roof is wood, covered with roofing paper.

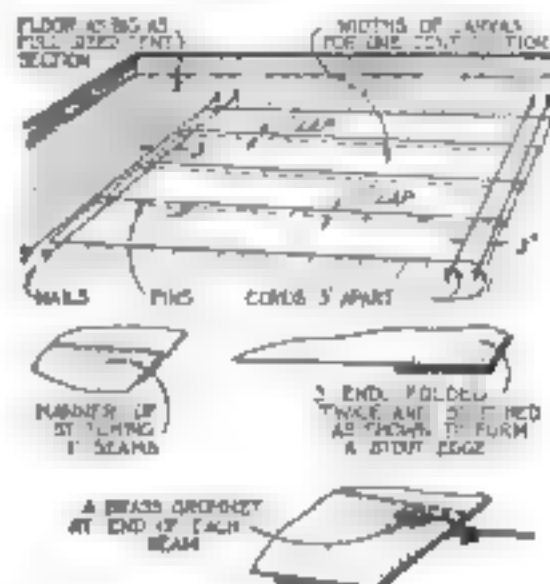
The roof of the tent itself can be wood, if preferred, like the roof of the veranda. Of course no guy rods would then be necessary.

The lumber list for a camp of the size illustrated is as follows:

For foundation, 2 or better 121 pcs. 8 by 8 in. by 2 ft. chestnut posts and 3 pcs. 4 by 4 in. by 10 ft. 6 in. oak or yellow pine sills.

For the tent proper, 7 pcs. 2 by 4 in. by 17 ft. 6 in. floor joists; 2 pcs. 2 by 6 in. by 13 ft., cross floor joists at ends; 8 pcs. 2 by 4 in. by 6 ft., tent guy rail posts; 8 pcs. 2 by 6 in. by 5 ft. 6 in. tent guy rail post braces; 4 pcs. 2 by 2 in. by 15 ft., tent guy rails; 6 pcs. 2 by 4 in. by 5 ft. 6 in. studs; 2 pcs. 2 by 4 in. by 13 ft. plates; 4 pcs. 2 by 4 in. by 8 ft. 6 in. rafters;

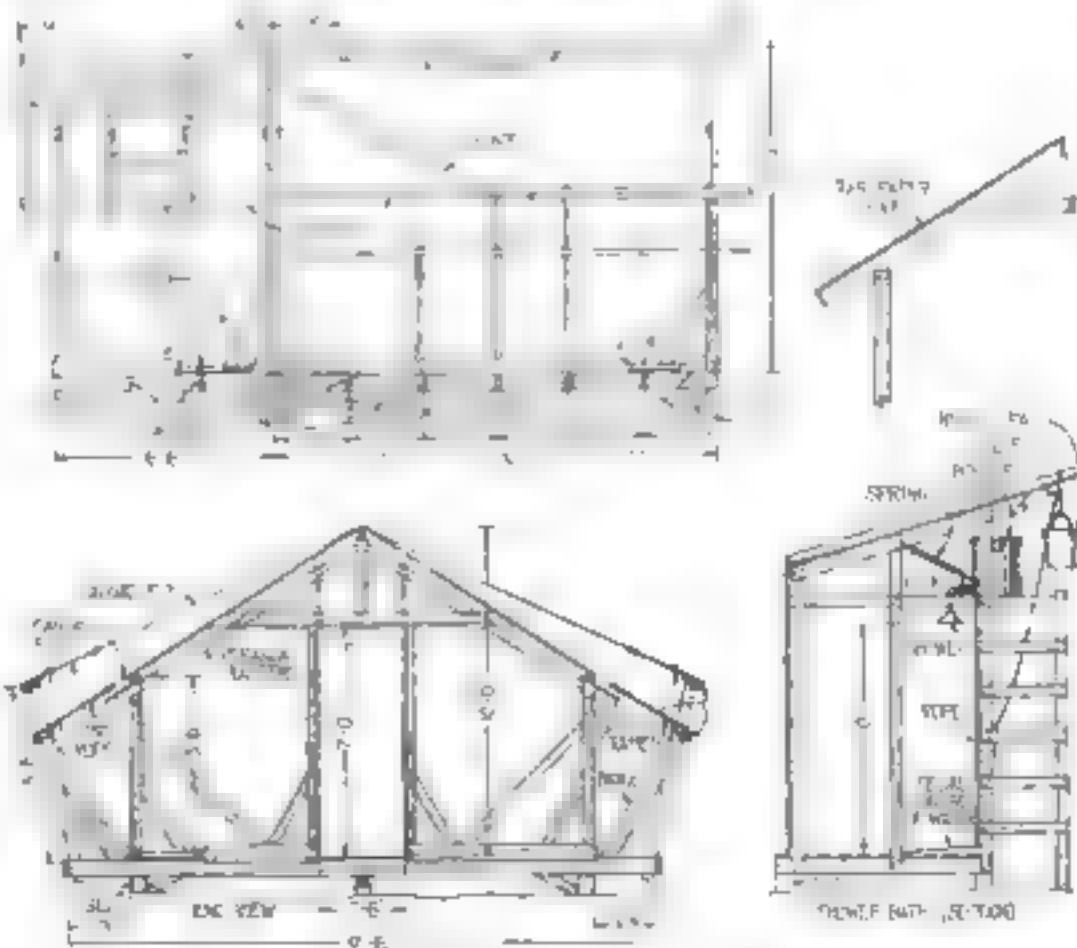
1 pc. 2 by 4 in. by 15 ft., ridge pole; 2 pcs. 2 by 2 in. by 8 ft., ridge pole braces; 12 pcs. 2 by 4 in. by 3 ft., corner braces; 2 pcs. 2 by 4 in. by 7 ft., door posts; 1 pc. 1 by 5 in. by 10 ft., cross door top piece; 1 pc. 2 by 4 in. by 9 ft., cross door top piece; 2 pcs. 2 by 4 in. by 17 ft. 6 in., plates on floor (across veranda and house); 2 pcs. 2 by 4 in. by 6 ft., plate on floor at door end; 1 pc. 2 by 4 in. by 5 ft.,



Each canvas section is laid out on the floor, pinned, and then heavily stitched.

ridge pole support; 2 pcs. 2 by 2 in. by 8 ft. 6 in. door tension pieces; 2 pcs. 1 by 6 in. by 13 ft., floor sides at sides; 2 pcs. 1 by 6 in. by 6 ft., floor sides at end; 240 sq. ft. flooring.

For veranda, 2 pcs. 2 by 6 in. by 14 ft., floor joists; 2 pcs. 1 by 6 in. by 6 ft., floor sides at end; 2 pcs. 1 by 6 in. by 6 ft. 6 in., floor sides at sides; 4 pcs. 2 by 4 in. by 7 ft. 6 in., plates; 8 pcs. 2 by 4 in. by 6 ft. rafters; 8 pcs. 2 by 4 in. by 4 ft. 6 in., studs; 8 pcs. 2 by 4 in. by 5 ft. corner braces; 2 pcs. 2 by 4 in. by 7 ft., door posts; 1 pc. 2 by 4 in. by 9 ft. 6 in. ridge pole; 4 pcs. 2 by 4 in. by 6 ft., veranda rail; 115 sq. ft. flooring; 150 sq. ft. sheeting for roof.



Side and end view of the framework, details of the veranda roof, and a section through the shower bath, which is built entirely separate from the canvas house.



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A Ball Bearing Merry-Go-Round

WITH a few pieces of lumber left over from building a house, an iron post, two discarded automobile bearings and some canvas, W. E. Robertson of Pelican, La., built the merry-go-round illustrated.

A 2-in. iron post 7 ft. long was set in the ground and fixed rigidly upright with concrete. A ball bearing was placed over the post on the concrete. On this was set a piece of lumber 2 in. thick and 12 in. square, a 2-in. hole having been bored in the center.

The bottom frame, in the form of a large cross, was made of two pieces 2 by 4 in. by 8 ft., with an outside rim of 1 by 4 in. boards. The frame was bored to go over the post and then fastened to the bottom of a long, narrow box made to enclose the post. It was also fastened to the block resting on the ball bearing.

The frame was floored with light boards and fitted with a railing of ½-in. pipe set 16 in. above the floor. An 18-in. opening was left for an entrance and four seats were fastened to the floor.

Over the post and within the upper end of the boxlike casing, a roller bearing was placed. The swing frame, 8 ft. in diameter like the floor, was made of four 1 by



This easy turning little merry-go-round was made almost entirely of odds and ends

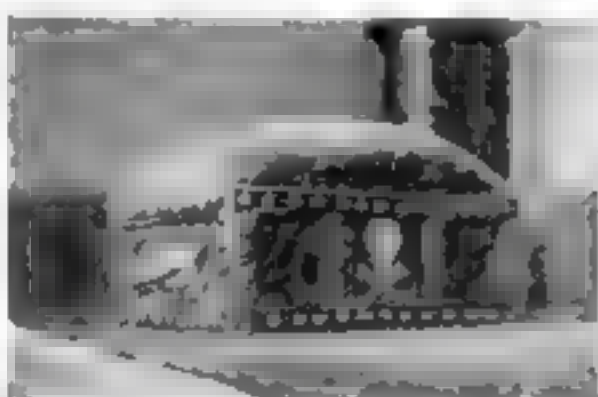
6 in. by 8 ft. boards, tapering from 6 in. at the center to 1 in. at the ends. The outside rim was formed by ¼ by 2 in. strips.

Usually one child sits in the entrance pushing on the ground with one foot to keep the merry-go-round turning, but the friction is so little that a child in one of the seats can keep it moving simply by pushing on the ground at intervals with a stick.—D. H. Rusk.

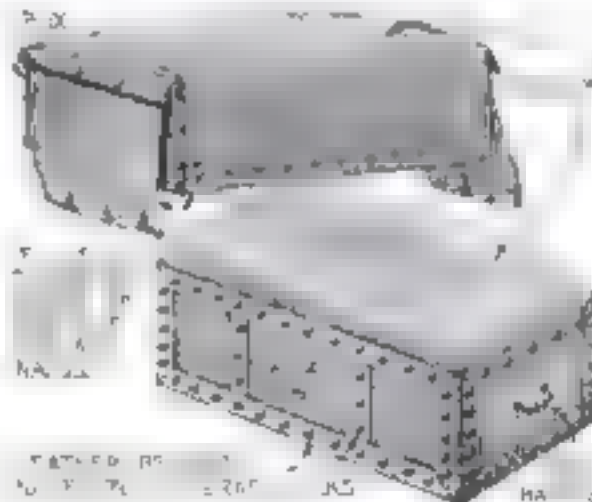
Footstool Made in Form of Old Treasure Chest

A GROCERY box, some tan canvas from an old army tent, a piece of leather belting, a discarded cushion, a few brass headed upholstery nails and various odds and ends were converted into the treasure chest footstool illustrated.

The box was turned upside down, padded with the cushion and covered with canvas. The edges were trimmed with leather belting and handles were added. Then a skull-and-crossbones design was painted on the sides.—L. A. LANGRISH



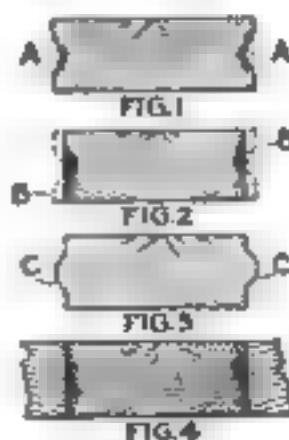
The footstool is a grocery box padded with an old cushion, covered with canvas, and ornamented with leather belting and tacks



How to Make a Wooden Joint Water-Tight

WOODEN tanks, pipes, decks, floors, partitions, and sills can be made water-tight or practically so if the joints are prepared as indicated in the accompanying diagram.

The edges are grooved by compressing, not removing, the wood, as at A, Fig. 1. In the absence of suitable tools or machinery, this may be done by hammering or pressing a steel rod into the edge of the board or plank as far as can be done without breaking the



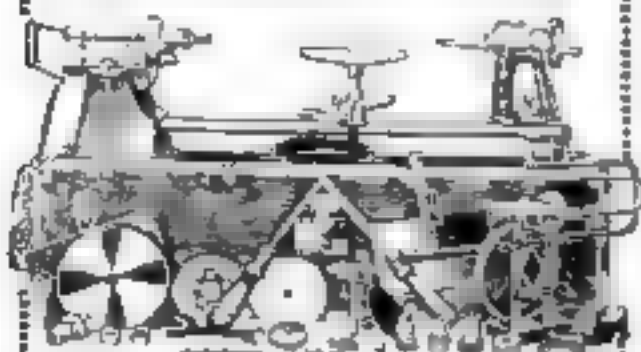
The four steps in forming the joint

wood fiber. The edges then are planed to the bottom of the groove, as at B, Fig. 2.

If water is applied at this stage it is obvious that the compressed fiber will expand, as at C, Fig. 3. Therefore, when planks or boards so prepared are nailed edge to edge, the effect of moisture is to make the joints watertight.

Any blacksmith can forge a flat, hooklike tool to be used with a hammer in making the groove.

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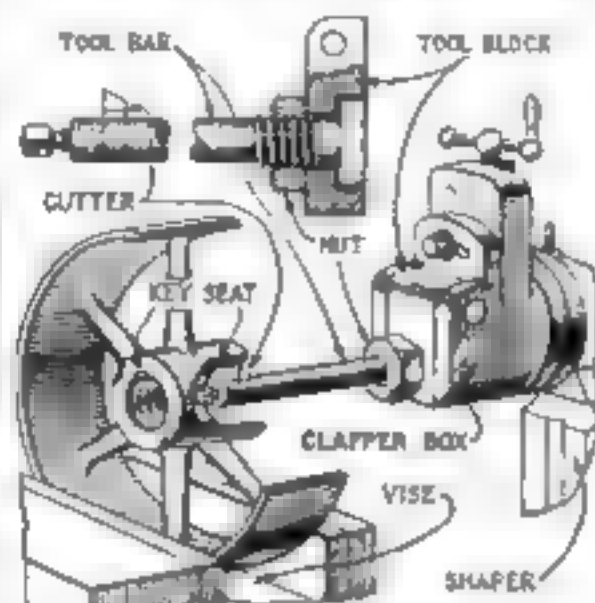
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Using a Shaper to Cut Internal Key Seats

WHILE the larger shops do their keyseating of pulleys or gears on special machines and the lone mechanic in a factory repair shop must cut his with a chisel, there is a stage where neither method is exactly suitable.

Small shops frequently do such work on the shaper. That, however, is not so easy unless the proper equipment is provided. The accompanying illustration shows a tool holder that is useful for this work. It fits in the clapper block in



A shaper tool holder for keyseating, which replaces the tool post in the clapper block.

place of the usual tool post. A large nut holds it tight.

Notice that there is no set screw shown in the side of the clapper box, and that the tool cuts on top. With the tool cutting on top, there is no need to back the clapper. Of course, the same tool holder can be used for cutting on the bottom or side, as for die work, but for keyseating better results will usually be obtained if the tool is made to cut on top as shown.—J. E.

Quick Way to Draw Threads

(Continued from page 107)

both ends, or a flat can be filed on top and the number placed there.

For the finer threads, it is best to glue a piece of cardboard about .010 in. thick to the foot surface, with the edges about 1/16 in. back from the foot diameter, as shown at B. This will enable the draftsman, by slightly inclining his pencil to get under the edge and thereby to produce a more accurate form.

There is no comparison at all between the rapidity with which work can be done with one of these triplets and the usual way of laying out the thread, with divider and triangle. The templet method lays the work out so that the division is even and true. Puncturing of the paper with divider marks is avoided, and most of the usual auxiliary lines are unnecessary.

For most purposes the lines produced with the aid of the templet, if made with a sharp pencil, will be sufficiently good without any further work, but even where it is desired to sharpen up the drawing or to trace it in ink, the work will be greatly facilitated by the even height and spacing of the threads.



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Too Big for a Lathe

(Continued from page 111)

there is no use in trying to get a power
feed for so short a job.

The mill foreman was beginning to
absorb some of the spirit which ani-
mated Lamons, and he set off to get
more men. When they arrived, Old Bill
gave a few directions as to how to pro-
ceed and said, "I am going back to
town now. Your men here have the
idea well in mind, and will get it carried
out, I am sure. I will come out tomorrow
morning to see how they are getting
along."

With that he went out to his car,
feeling glad that he had come across a
man who was capable of carrying out,
yes, even anticipating, his thought.

The following morning he was on the
job early. There were holes drilled in
the floor. Some men had stayed all
night to put them in. The machine
parts were near by, and the boxes
prepared.

"You wanted to pour the boxes
against the shaft?" the machinist asked.

"Certainly," Old Bill replied. "I see
you have the old metal out of them."

"The drive is just about fixed up, too,"
Lamons informed him. "I have figured
the pulleys to run the shaft about forty
feet a minute."

OLD BILL lingered a while, then
went to the office to talk to the
owners. He was interested to see how
well the mill crew would get along with-
out his guidance. They progressed very
nicely, for a couple of hours later a man
came in to say that the outfit was ready
to go.

So Old Bill returned to the mill and
saw the wheel in motion. He noticed
that it ran perfectly true, which showed
that the shaft was not bent. The ma-
chinist was adjusting the centers.

When he had the wheel revolving to
suit him, Lamons stopped the shaft
and again checked the alignment of the
milling machine table. This he did by
adjusting the tool at one end of the
journal until his feeler gage would just
fit in between the unworn part of the
shaft and the point of the tool. Then
he ran the tool to the other end of the
journal and tried the feeler between the
tool and the unworn portion at that end.
It fitted just as well, which showed
Lamons that the journal he was about
to turn would be straight. Then he
began the turning.

He was careful not to take off more than
was necessary, and he gave particular
attention to the honing of the tool in
order to produce a smooth surface with-
out having to file the bearing excessively.

The long end of the shaft was turned
first. The milling machine table then was
moved and lined up with the journal on
the other end of the shaft. Here it was
necessary to tighten up the centers so
that they took the weight of the wheel.
The box was left in place to catch the
shaft should anything happen to the
centers. That made it desirable to fit a
scraper to keep the chips from being
dragged down into the babbit with the
possibility that the finished surface

would be scratched during the turning.

Old Bill looked on at the proceedings,
giving a suggestion when called for, and,
after a time, when the second journal
was being turned, decided that he would
go back to town.

"There is nothing else that I can do,"
he remarked. "About all I have done
for you is to look up your own material
so that you could do your job. I shall
have to think a while for a name for
this sort of service."

"We have not been disappointed,"
the mill foreman assured him heartily.
"We did not know how to get going,
and you showed us."

"Well, that's really about what I do
in my own shop," Old Bill returned.
"There are two essentials to getting
work out: the planning in advance, and
the actual doing. I suppose that, after
all, it is rarely one man can do both.
My field seems to be the planning."

He drove back to town, pleased alike
at the success of his scheme and the
thought that sooner or later he might
be able to add one exceedingly com-
petent mechanic—Lamons by name—to
his own shop forces.

Assembling Pipe Wrench with Aid of Paper Wad



How crumpled paper is inserted in a pipe
wrench nut to hold the nut guards in place

IN ASSEMBLING the type of pipe
wrench shown in the illustration, it is
difficult to hold the nut in the frame, and
at the same time keep the nut guards in
place. A trick to make the guards behave
is to put a wad of paper between them in
the nut. When the jaw enters the nut,
the wad of paper is pushed out.

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SMALL steel
punches for
stamping num-
bers on metal are
easily lost. To
hold them in the
usual wooden
case, merely
stretch a rubber
band around the
protruding ends,
as shown.—
FRANK W. BENT-
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Punches are held in
place by rubber band

BEFORE being babbitted, cast iron bear-
ings should be heated to about 450 deg. F.



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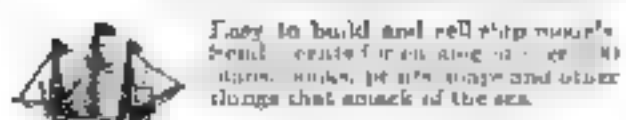
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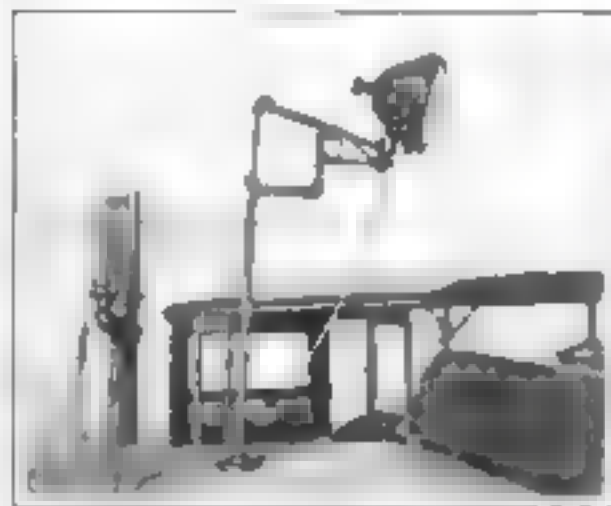


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Controlling Searchlight from Motor Boat Cabin

A MOTOR boat searchlight can be controlled in rainy or cold weather without opening the pilot house window, if it is mounted as shown.

The standard is a piece of 1-in. pipe 5 ft. long with a T fitting at the upper end. A 10-in. length of pipe, an elbow and another piece 8 in. long are added, and the light is clamped to the latter. A



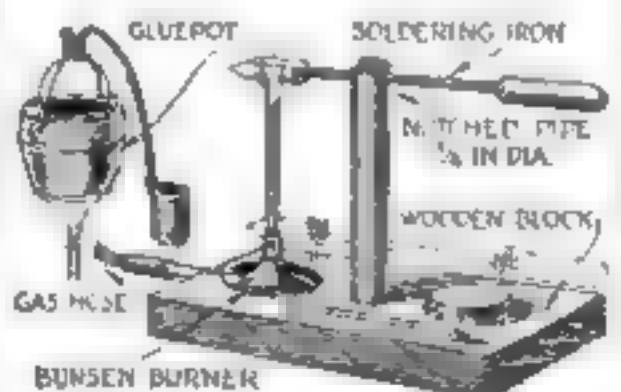
From within the pilot house this boat searchlight can be pointed in any direction.

7 ft. length of $\frac{1}{2}$ -in. pipe runs upward through the 1-in. pipe and is connected to the light as indicated. As the lamp itself has a ball-and-socket connection on its clamp, it is possible to turn it to port or starboard by means of the 1-in. pipe, which is heavily taped inside the cabin to form a convenient grip. The $\frac{1}{2}$ -in. pipe is pushed up or pulled down to control the vertical movements of the lamp. —CARLTON GHOAT

Small Soldering and Glue Kit

SOLDERING iron and gluepot are household essentials. To keep them ready for instant service, I make use of the stand illustrated.

The pipe that supports the soldering iron or gluepot is screwed tightly into a hole in the center of the wooden base



A convenient and inexpensive stand for a Bunsen burner, soldering iron and gluepot.

block. When the gluepot is to be used, a stiff wire, which is bent into a hook at one end, is thrust down to the bottom of the pipe. The gluepot is the smallest commercial size, but is large enough for ordinary purposes. —B. A. CHAMBERLIN

To make a paint and varnish remover, mix $\frac{1}{2}$ lb. melted paraffin wax, 1 gal. benzol, $\frac{1}{2}$ gal. methyl acetone and $\frac{1}{2}$ gal. denatured alcohol. Stir thoroughly



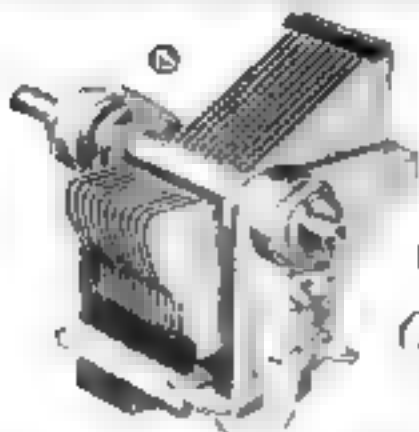
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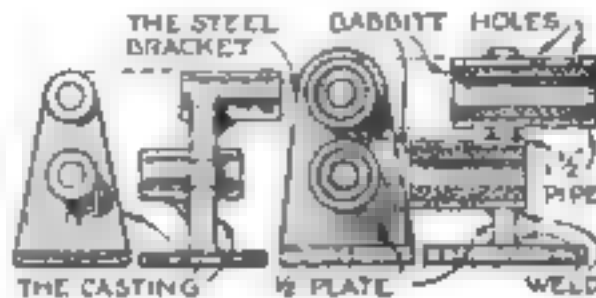
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Welded Steel Bracket Replaces Casting

IN AN industrial plant well away from shops and foundries there was a duplex steam pump to feed the boilers. A piece of pipe fell on it one day and shattered the valve gear bracket so badly that it was even beyond welding.

This did not stump the ingenious plant mechanic. He found two pieces of pipe and two pieces of half-inch plate and welded them together to make a part like



The original casting is shown at the left and the built up welded bracket at the right

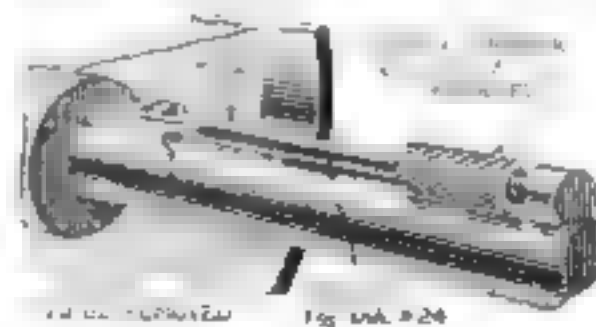
the broken casting. Then he drilled a number of holes through the pipes to anchor gabbott. Each of the pipes was filled with gabbott and when cold the metal was expanded into the pipes by hammering.

To all intents he had a rough casting now. It was a simple matter to lay off the necessary holes and then drill them. The gabbott formed a wearing surface as good as the cast iron of the original, and the steel was amply stiff.

Tool with Sliding Hammer Removes Gib Head Keys

GIB head keys are much easier to remove than those without heads, provided one is able to drive against the head. However, when the key is in a wheel pulley or gear, there is no opportunity to drive them out in the usual manner.

To take care of such conditions we made the key puller illustrated. At one end of



A powerful key remover for gib head keys that cannot be driven out easily by sledgeing

a bar an eye was forged that would fit over the gib head while at the other end was a solid head. Sliding between, on the body of the bar, was a piece of shafting that served as a hammer. With the eye hooked over the head, the hammer was slid back and forth over the bar, striking the solid head, and quickly pulling out the key.—ARTHUR ZEPHANIC, JR.

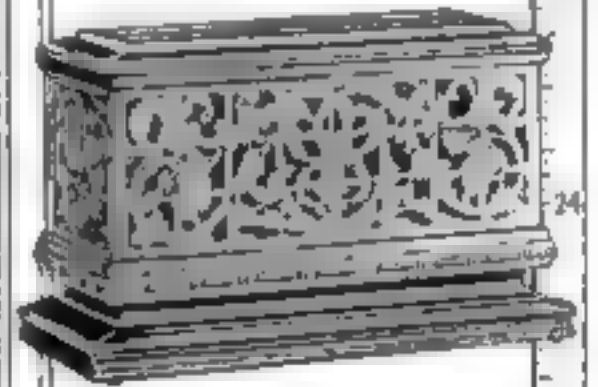
Taps, drills and reamers can be reduced in size from .005 to .01 in. by immersing them in a solution of nitric and sulphuric acids. The amount of reduction depends upon the time they are left in the bath.

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in a cabinet
only 18" long

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Statement of Benjamin M. Hargrave, President of the American Association of Publishers, dated June 1, 1927, before the Senate Committee on Education and Labor, New York, N. Y.

I, Benjamin M. Hargrave, President of the American Association of Publishers, do hereby certify that the following is a true and correct copy of the statement of Benjamin M. Hargrave, President of the American Association of Publishers, dated June 1, 1927, before the Senate Committee on Education and Labor, New York, N. Y.

Witness my hand and the seal of the American Association of Publishers, at New York, N. Y., this 1st day of June, 1927.



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Why be a slave to gas and oil? Why bother with tire and engine trouble? Plan to leave your cares behind this summer. Get a genuine "Old Town Canoe" and set forth on the water trail.

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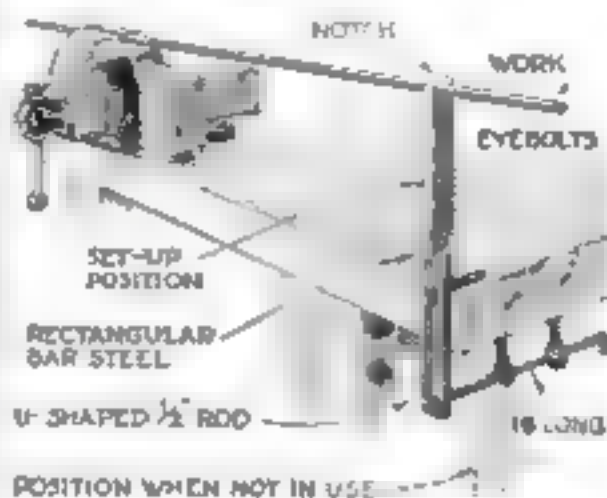
"Old Town Canoes"

A 2c STAMP —will start you on the road to success. See Money Making Opportunities on pages 120 to 143.

Auxiliary Support for Work Held in Vise

WHEN there is a long piece of work to be held in a vise, the machinist sometimes piles up boxes, pulleys, or any thing at hand to support the end of it.

The accompanying illustration shows a support for such work that is always



How the support, which disappears under the bench when not in use, steadies a long rod.

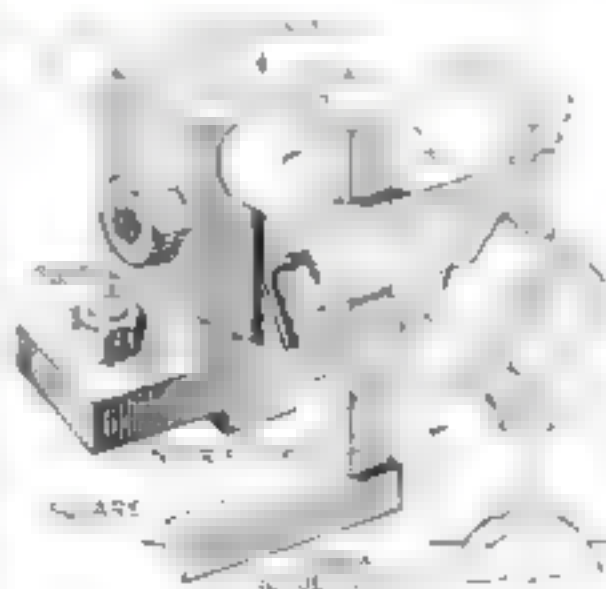
handy when wanted, but never in the way. It is arranged to swing down when not in use. The bar with the notch at its upper end is made of $\frac{1}{2}$ by 2 in. flat stock twisted as shown. Two holes are drilled in it for the U-shaped $\frac{1}{2}$ -in. rod. One end of the bent rod rests on the top of the bench when the support is in the raised position and effectively locks it in place.

The dotted lines show the support when lowered and pushed out of the way under the bench.—H. MOORE.

Guide for Centering Key-Seat Cutters

By G. A. LERS

SETTING a key-seating cutter above the center of a shaft is tedious when the shaft is some odd diameter and bothersome if the cutter is covered with oil, so



A V-block for centering key-seating cutters accurately, and a fixture for holding shafts.

a number of machinists make a practice of guessing at the location and letting it go at that. If they have not guessed well enough, the key seat will be off center and will not match perfectly with the key seat in the hub. The key cannot be well fitted

in such a case, and is likely to cause trouble, especially where the drive runs first one way and then the other.

To obviate this trouble and at the same time to expedite the work, one enterprising machinist made up a double V like that shown in the accompanying illustration. This V was made to fit the blade of his try-square, and in use was rested on the shaft. Then the cutter was lined up with the upper V. By this procedure he was sure that the milling cutter was directly above the center of the shaft and that he would have an accurate key seat.

The illustration also shows a fixture for holding shafts for keyseating that is a departure from the usual custom. It has been found more satisfactory than V-blocks, particularly where there are a number of shafts of the same size to be keyseated, as in machine building plants. It is made of cast iron with a hole bored to receive the shaft. A tongue on the bottom fits the T-slot in the mating machine table. Bolts are provided to secure the block to the table, and there is another bolt to clamp the shaft being keyseated. The spring of the casting releases the shaft when the clamp bolt is loosened.

The clamp can be made for any size shaft, and it is possible to have split bushings to adapt it for use with smaller shafts.

Bending Tongs and Spring Clamps for Tin Shop

TWO simple devices are illustrated that have proved extremely useful in a Denver tin shop.

The first is a pair of rivet heater tongs with wide jaws. These are 4-in. strips of $\frac{1}{2}$ by 1 in. iron ground to an edge from the outer sides and welded on each jaw of



Rivet heater's tongs with wide jaws welded to them for bending tin—a set of spring clamps.

the tongs. The tool is handy for bending light sheet metal.

The other is a clamp that may be slipped or slid over sheets of metal, clothespin fashion, pinning them firmly to the work bench. A set of these is made of spring steel, about 6 in. long and $\frac{3}{8}$ in. thick. The one shown on top of the bench illustrates the shape.—JAMES C. COYLE.

Cutting Pulley Oil Grooves

INSTEAD of chipping oil grooves in pulleys or bushings, they can be cut by putting a properly shaped tool in a boring tool holder and working the lathe carriage back and forth by hand while the pulley is stationary.



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Compensating Blocks for Wooden Bench Vise

By CHARLES M. MILLER

BENCHES in many home workshops and in the majority of manual training shops are fitted with wooden vises of either the cabinetmaker's or carpenter's type. When a board is clamped at one end of a wooden vise the jaw usually is twisted out of parallel with the bench top. This is bad alike for the vise and for the work and in time the vise may split and become so loose that it will not operate satisfactorily.

By inserting a block of the same thickness as the work in the opposite end of the vise the strain becomes equalized. It is a simple enough matter to keep on hand



A set of two vice compensating blocks of the built-up type, and a one piece block in use

suitable blocks of the more common stock pieces of dressed boards. Still more convenient are the blocks shown above.

Blocks such as those in the upper illustration will serve most purposes. One is made of a piece $\frac{3}{4}$ by 2 by $8\frac{1}{2}$ in. and a piece $\frac{1}{2}$ by 2 by $4\frac{1}{4}$ in. and a strip $\frac{1}{4}$ by $\frac{1}{4}$ by 2 in. The other consists of a piece $\frac{1}{2}$ by $1\frac{1}{2}$ by $8\frac{1}{2}$ in., a piece $\frac{1}{2}$ by $1\frac{1}{2}$ by $4\frac{1}{2}$ in., and a strip $\frac{3}{8}$ by $\frac{3}{8}$ by $2\frac{1}{2}$ in.

The reason the cleat for the second block is made $2\frac{1}{2}$ in. long is so that the ends will project enough to prevent the block from sliding down through the vise when it is used edgewise to compensate for work $1\frac{1}{2}$ in. thick.

Another type of block made of solid stock is shown in the lower illustration. It has a projecting screw to prevent slipping when the thickest section is in use.

Redwood for Ship Model Making

FOR making blocks and deadeyes for ship models, I have found that redwood is easily worked and does not split readily. Strips cut from an old T-square were utilized for this purpose in my own case. The wood is of such a color that no varnish or paint is necessary.

—E. A. D'ARMER.

We Pay for Ingenious Shop Short Cuts

WHENEVER you work out some way of doing a job that is a little quicker or easier than usual, remember that you can, perhaps, turn the idea into cash by sending it to the Better Shop Methods Department of POPULAR SCIENCE MONTHLY, 230 Fourth Avenue, New York. You will be helping other mechanics by passing on your labor-saving "kinks," and at the same time may earn some extra money.

Make a rough sketch to show what you have accomplished and write out a brief description. You may write with pencil, if you wish; it's the idea that counts, not the form. Have a photograph taken, if possible, showing just how you did the work or what the tool, fixture, machine or product looks like.

If your suggestion is one that can be published in this department, a check will be sent you promptly, the amount depending upon the originality and utility of the idea rather than the length of the description.

Cleaning Device Keeps Shafting Polished

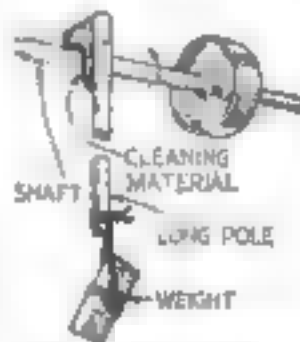
EVERY mechanic takes pride in a shop that is clean and free from rubbish. He likes to have his tools on his workbench when in daily use or in the tool box if needed on a few occasions.

While keeping the shop clean, do not forget the shafting above. In a week's running, the shaft will gather a great deal of flying dust or shavings. This dirt can be removed easily if the shafting is cleaned once a week, say every Saturday morning.

A rod of wood of convenient length serves as the handle of the device. This strip should come within a few feet of the floor when in use. At the top end is nailed a short block shaped as shown on the inside edge to fit over the shaft. Strips of abrasive are fastened to the inside of the block.

The device is hooked over the shaft and a weight fastened to the end of the pole. This pulls with sufficient force to wipe off all the dust and tarnish. After one section is cleaned, move the cleaner to the opposite side of the next pulley to clean and polish a new part of the shaft.

—H. E. WENGER.



The cleaner hooked over the line shaft

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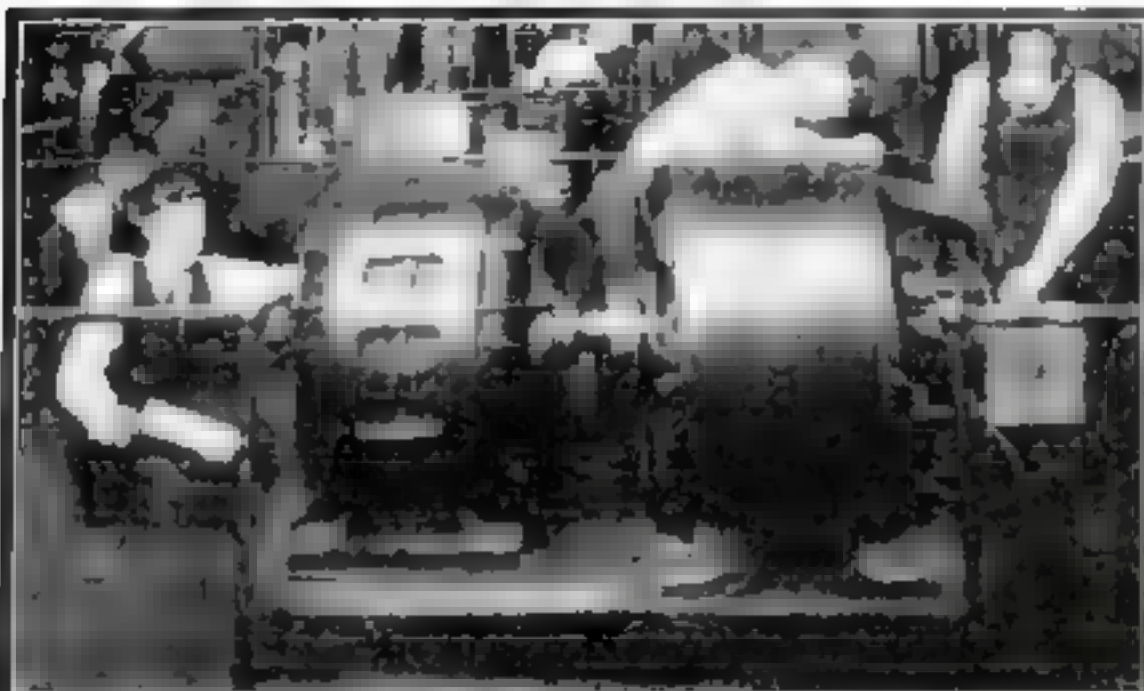
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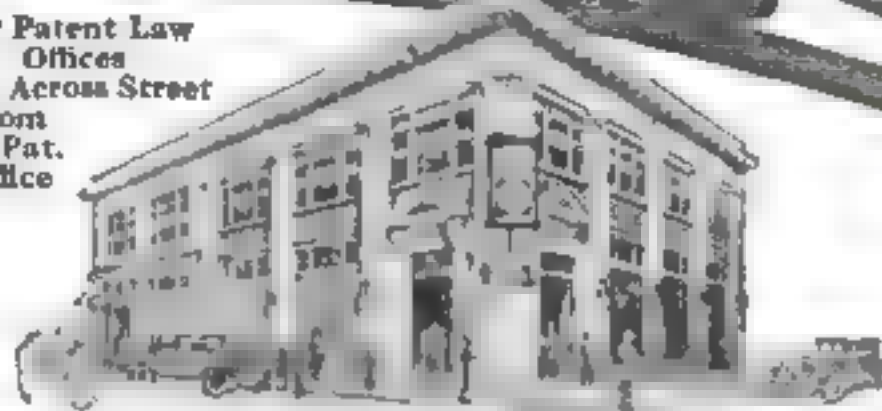
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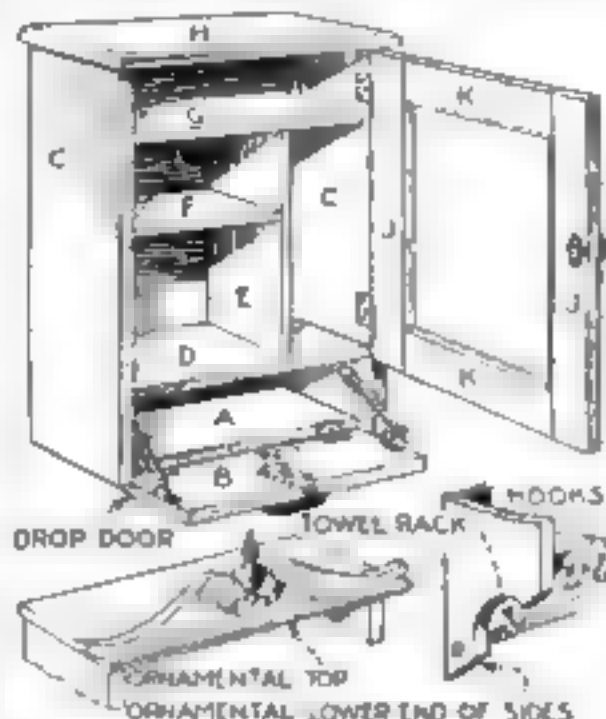
Wall Cabinet Has Handy Shaving Shelf

By H. A. BAILEY

WE MEN—and boys too—who make things for our home generally get less use out of such articles than do the other members of the household. Here's a project, however, that will please every one. It is a bathroom medicine cabinet with a special shaving outfit compartment that has a drop-door shelf. This door gives ready access to the shaving

it is desired to ornament the cabinet, and a curve sawed out either with a coping saw or a band saw, if one is available. This extension makes it possible to add a towel bar and toothbrush hooks. The top also may be ornamented in some such way as suggested at the bottom of the accompanying drawing.

As the cabinet is intended to be finished either with two coats of flat white paint and one or two coats of white enamel, or two coats of shellac and two or three coats of white brushing lacquer, it is possible to use any close grained wood such as poplar, white pine or whitewood.



Shaving articles on the lowest shelf can be reached without opening the mirror door

articles without interfering with the use of the mirror in the large door above it. The interior of the cabinet is arranged for packages and bottles of various sorts and sizes.

No trouble will be encountered in building the cabinet if the sides, top, bottom and shelves are cut accurately to the sizes indicated in the accompanying bill of materials.

Dadoes (grooves) are cut in the sides C $\frac{3}{4}$ in. deep to take the shelves D and G. The dadoes are stopped 1 in. from where the front edges of the shelves are to come and the shelves themselves are notched out to suit. The shelf F also is housed $\frac{3}{4}$ in. deep in side C. The sides, top and bottom are rabbeted $\frac{3}{4}$ by $\frac{1}{2}$ in. to receive the back, which may be wall-board, plywood or any thin material.

The mirror door should be so made that the space rabbeted out for the mirror will be $11\frac{1}{4}$ by $14\frac{3}{4}$ in., although the glass itself will be slightly smaller than this. The door may be made with mortise and tenon joints or doweled together, or even constructed with mitered corners such as are used in an ordinary picture frame.

The side pieces may be extended for some distance below the bottom shelf, if

Bill of Materials

Parts	Pieces	T	W	L
A Back board	1	14	4	15
B Towel rack	2	24	4	15
C Sides	2	34	5	1
D Shelf	1	34	4	15
E Top	1	34	4	15
F Drop-door shelf	1	34	4	15
G Shelf	1	34	4	15
H Ornamental top	2	34	4	15
I Back board	1	14	4	15
J Hinge	2	14	4	15
K Door	1	34	4	15
L Back board	1	14	4	15
M Towel rack	2	24	4	15
N Shelf	1	34	4	15
O Top	1	34	4	15
P Drop-door shelf	1	34	4	15
Q Shelf	1	34	4	15
R Ornamental top	2	34	4	15

Your Home Workshop Problems Solved by Experts

FEW questions that arise in connection with your home workshop or such repair jobs as you do about the house have not been fully answered in past issues of POPULAR SCIENCE MONTHLY. If you had a complete file of the magazine, properly indexed, you would have an encyclopedia of extraordinary completeness.

We are constantly referring readers to past issues, which contain the articles they wish. These back issues are supplied from our own reserve stock at 25 cents each.

Some of the articles to which we have recently referred readers are:

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| Toys from Old Tin Cans | Dec. 1926 |
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| How to Make Dovetails | Oct. 1926 |
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| Refinishing House Woodwork | July 1926 |
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A medicine cabinet of unusual utility

Transferring Pictures on Glass and Porcelain

By ERNEST BADE

PRINTED pictures on paper may be transferred to glass for the purpose of making transparencies or even lantern slides. First thoroughly clean the glass and cover it thickly with dammar varnish or Canada balsam thinned with turpentine so that it flows freely. Set the glass aside until the varnished surface becomes tacky.

The paper is soaked thoroughly in water and then pressed on the tacky varnish with the picture facing the glass and dried with blotting paper. The paper may be removed by rubbing it carefully with a wet finger. The glass will retain the picture on its varnished surface.

By similar methods prints may be transferred to metal or porcelain. A varnish known as French varnish is used. This consists of gum sandarac, alcohol and Venice or ozonized turpentine. One teaspoonful of gum sandarac is dissolved in about 4 oz. of alcohol and 8 teaspoons of ozonized turpentine are added. Ordinary turpentine cannot be used, as it will not dissolve in the alcohol.

The material upon which the print is to be transferred is covered thickly with this varnish and when the surface is tacky, the back of the paper is moistened, the printed side lightly covered with the varnish, and the print firmly pressed in place. Not less than twenty-four hours later the paper is moistened with water and the fibers are rubbed off.

Under these conditions the print will be reversed. Should it be necessary to transfer the picture as originally printed it may be accomplished by incorporating an extra step in the process.

Moisten the back of the paper, varnish the picture side quite thickly and let it dry. Fasten a clean sheet of paper to a drawing board and cover it with one or two layers of carpenter's glue. When both papers are dry, the varnished surface, which contains the picture to be transferred, is also coated with glue and pressed upon the prepared paper.

As soon as the glue has hardened sufficiently, the back of the paper containing the picture is moistened with dilute hydrochloric acid, which is absorbed by the fibers. With the aid of a little water, the surface is rubbed gently with a finger to remove the paper. Since the glue is softened by water, the paper must be permitted to dry so that the lower surface will not be destroyed. Then the process may be repeated.

When all of the fibers have been removed, the picture is again visible. It must be varnished, pressed firmly upon the metal or porcelain background, and permitted to dry for twenty-four hours. Finally the paper is soaked in water and removed. Should any glue remain on the picture, it may be washed off.



The print is stuck in place with varnish

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Black Death

(Continued from page 125)

"See how we feel, captain?" said the machinist grimly. "Guess we'll all stay." He glanced at DeFrees. "Unless the doctor wants to try his gadget."

"Of course I do!" burst DeFrees. Plainly he would not desert his creation even in the face of death. He turned to the commander.

"I can trust you to let me go," he said, half questioningly.

"You can," replied Drake. "That is, if she will let go."

Like a snake the wretched man wormed his long body through the doorway of his "Detachable Turret." Drake closed the watertight shield after him. In dead silence the crew watched the curious performance. Presently a small point light by Drake's hand blinked. He threw over the releasing lever.

Behind the bulkhead sounded a thump, followed by the splash of rushing water.

Involuntarily the men crowded forward. For some of them the moment of heroic determination to stick by Drake had passed. Now they saw the last straw of hope snatched away before their eyes. Was it possible that Drake was wrong and the civilian right? How could they judge? One of them groaned aloud.

Drake still stood before the operating lever. Only a few seconds had passed, though it seemed years since he had made the move that would have sent the inventor hurtling toward the surface. Suddenly, with a cry, he wrenched the operating lever back into place.

"It didn't let go!" he panted. "The man's drowning!"

Securing bolts were replaced. The turret's door was opened. Into the X-5 rushed more gallons of water.

Drake leaped through and seized the limp shoulders of DeFrees and hauled him out. The man was unconscious but still conscious.

One of the sailors brought his hammock, unfastening it as he came. "Here, captain, lay him on this." He placed the bedding on a foot locker raised above the level of the deck about which sloshed several inches of water.

DeFrees allowed himself to be stretched out. Then feebly he raised himself on one elbow. Tears coursed down his cheeks. "I—I suppose I was wrong," he said. He stretched a supplicating hand toward Drake. "You must save us, commander. Only you can do it." He sank back.

THE huddled men stayed like sheep toward their commanding officer. Consternation at the failure of Dr. DeFrees' vaunted device gave way to helpless panic. They were trapped. The frightfulness of it all paralyzed their faculties. The awful choking of gas victims seized one after another.

Now, if ever, Drake must show his leadership. Their only hope lay in somehow enlisting the aid of the *Falcon* just above them.

If only he could get one end of the submarine up, the men might cut their way out. That had been done on the *S-51*. But that boat's pumps worked. The *S-5*'s pumps now had collapsed. Moreover, the vast weight of water in her bow anchored her heavily to the bottom.

A dozen wild ideas flashed through his brain. But none congealed to practical form. He gnawed his fist and inwardly cursed his lack of magnification. From time to time DeFrees groaned and bubbled feverish demands for Drake to save him. One man sank cooling in the deck. Another fainted. If only they could be set to work!

Suddenly Drake clapped his hand on Harbord's shoulder.

"I've got it!" he shouted. "There's still a way out."

The men crowded about him eagerly. "Here's the idea. Before we left the yard I crawled over the X-5." (Continued on page 122)

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What It Costs to Build

(Continued from page 69)

2-in. with helper
130 blocks or 133 sq. ft.
Scaffolding rafters, siding, board measure
100 ft. B. M.
Floor joists
150 ft. B. M.
Plan board horizontal sheathing, wall or roof
500 ft. B. M.
Diagonal matched sheathing 300

In siding and in matched or tongue-and-groove sheathing the square feet of surface actually covered is about one quarter less than the board measure area given. To find how many studs the carpenter places according to the above figures, apply the rule for board measure. Multiply length in feet by thickness and width in inches, then divide product by twelve. Thus for a stud 2 by 4 by 12 (12 ft. long), multiply latter by two and by four which equals 96, dividing 96 by 12 equals 8 board measure. Now divide the carpenter's daily stint of 400 ft. B. M. by 8, and we find that he sets up 50 studs of the stated size in a day.

To estimate the labor timetable

Roofing—wood shingles, 700 to 1,000
100 sq. ft.
Lathing wood 1,500 with
80 sq. yds.
Plastering of stucco, three coats with helper
20 sq. yds.
Placing window frames in wood building
6 to 8 frames
Placing window or door frames in masonry
4 to 6 frames
Door frames, finished with trim 4 frames
Doors fitted, hardware a placed 6 hours
Inside stairs with balustrade 2 steps
Flooring (top or finished floor laid)

Painting outside wall one coat 120 sq. ft.
Painting inside one coat 100 sq. ft.
Papering room 100 sq. yds.

Time estimates for other work:

Steam heat one-pipe system with helper, per radiator 1 1/2 days
Hot water heat, with helper, per radiator 2 to 3 days
Plumbing, with helper, per fixture, including piping 1 to 2 days
Electrical work, with helper, metal cable, electric outlets per day 4 to 6

Plumbing costs six to eight percent of the total house value. Heating is about the same if steam or hot water, but two percent will cover a warm air one-pipe equipment. Wiring a house with metal cable costs usually three to four percent.

The labor in a job of carpentry was estimated at forty percent of material cost a dozen years ago. Since then materials have gone up about twice, while labor has advanced in some localities three times. Therefore in those localities today labor and material cost in wood construction are even.

Here are some useful figures for total costs, including material and labor

One outside wall, frame to lock \$20.00
Windows to each 15.00
Roof—terrace per sq. ft. 5.00
Wood joist 5 ft. wide per linear ft. 12.00
Floor joists including joists, A. C. joist per sq. ft. 55
Roofing wood shingle, per 100 sq. ft. 22.50
Lath and plaster two coats per sq. yd. 1.00

While in building there is satisfaction in getting value for your money, economy should not be an end in itself. The cost of a good job will be forgotten in its enduring comfort, but the triumph of undue economy is short lived.



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How Sea Flying Was Made Safe

(Continued from page 137)

banks grew thicker, the river traffic denser, until the clamor of sirens penetrated even above the noise of his engine.

Now the towering skyline of Manhattan came into view. He swung almost to the edge of the Palisades, then straight to a landing field at the northern end of the island. While his assistants filled the gas tank, Curtiss rushed to telephone the editor of the *World*.

"I have landed in New York City," he announced, "but I am going on down to Governors Island."

New York's millions watched, unbelieving, changing to amazement among the throngs that jammed windows and roofs along the river front. Curtiss flew out of his way to circle Liberty's tower, then dropped to a perfect landing on Governors Island parade ground.

One hundred and fifty-two miles he had flown, in an actual time in the air of two hours and fifty-one minutes, at an average speed of fifty-two miles an hour.

A wonderful performance, easily met by General Frederick Dent Venable, commanding officer at the Island, as he waved the flier's hand.

PEOPLE at last admitted that aviation had "arrived." Flyers everywhere were inspired to seek new records for air travel. Glenn Hamilton flew from New York to Philadelphia and back on June 14th in a Curtiss plane, the first round-trip flight between two large cities, winning the prize offered by the *New York Times*. On the 4th of July Curtiss at Atlantic City won the \$5,000 prize for the first aviator to fly fifty miles over the ocean. On the same day Walter Brookins in a Wright machine made a new world's altitude record—6,000 feet. Then, on August 30th, Curtiss made another world's record, the longest flight over open water, sixty-four miles over Lake Erie from Cleveland to Cedar Point and back again, in a driving rainstorm.

Aviation meets were held everywhere, the summer of 1910. Exhibition flying at Sheepshead Bay, New York, in August, with five Curtiss flyers in the air at once, a marvelous spectacle. Here McNulty of the old Aerial Experiment Association first demonstrated wireless communication between a plane and the ground. Claude Grahame-White came from England with a Blériot monoplane and at Boston beat Curtiss by a slight margin. And that was the end of Glenn Curtiss' air racing. Just as in the old bicycle days he stopped racing when he was beaten at Syracuse, now he concluded to let the younger fellows, his pupils, do the exhibition flying and racing while he devoted his time to developing the airplane, inventing improvements.

THE international challengers went after the Gordon Bennett cup again that summer. Curtiss had built a monoplane, but at the last minute decided not to fly in defense of his trophy. Eugene Ely competed in a Curtiss biplane. A. J. Drexel, Jr. was a contestant in an improved Blériot. The Wright brothers entered, so did Hamilton. Alfred Leblanc, the French contestant, had probably the fastest machine, but crashed into a telegraph pole at Belmont Park, and Grahame-White, the Englishman, flying a French machine, took the International Cup back across the Atlantic.

Now the Army and Navy began to get interested in flying. Congress made trifling appropriations for flying experiments—\$125,000 for the Army, \$25,000 for the Navy! Curtiss offered to teach, without charge, all the Army and Navy officers whose departments might detail to learn to fly and, early in 1911, established the famous

(Continued on page 142)

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How Sea Flying Was Made Safe

Continued from page 141

flying port at San Diego, with five pupils. Now, besides getting the Army and Navy into the air Curtiss wanted to demonstrate his own earliest theory that flying over water could be made as safe and as practical as flying over land. The *New York World* suggested transportation by airplane of a message from a ship at sea to shore. A platform was fixed on the after deck of the Hamburg-American liner *Pennington*, from which McCurdy was to fly back to New York from outside Sandy Hook. But a careless mechanic left an oil can on the platform. McCurdy's propeller struck it and was shattered, and that first experiment proved nothing. But the cruiser *Albatross* was ready with a similar platform, and on November 14, 1911, Eugene Ely flew from ship to shore at Hampton Roads, Virginia.

It seems commonplace enough now, but the whole world got excited over that feat. "Now fly from shore to shore," said the Navy, and on January 18, 1912, Eugene Ely made a successful shore-to-shore flight, landing on the deck of the U. S. S. *Pennington* in San Francisco harbor.

At San Diego Curtiss and his mechanics were busy fitting up a plane that would float, carrying, resembling the prototype, onto the water in January, 1912. Curtiss took one of them out to see how it would behave on the water.

"I HAD no idea of going into the air at that time, though I knew it was possible," he told me. "Nobody had ever risen from the surface of the water. But this machine handled so beautifully that my action in elevating the plane was more instinctive than intentional. One second I was skimming the surface of the bay and in another I found myself in the air. It rose with a suddenness and ease that surprised me. I flew half a mile over land, turned and alighted on the water. Several naval craft in the bay tossed their crews in applause. I rose again from the water, this time unintentionally, and again alighted. I had got what I was after."

Now men could fly, anywhere. First the land routes had been conquered, now the sea. Only one more thing was needed to make the problem of world-wide flight to practical accomplishment. Now the airplane could fly from the shore to any ship, or from one ship to another, alighting on the water and being lifted aboard by the ship's tackle, as Curtiss had proved within a few days, when he flew out to the *Pennington*, was lifted with his plane to the battleship's deck, was lowered again to the water and then back to shore.

THAT was another great aviation year, 1912. The Navy bought two of the new airplanes. The Army bought four or five aircraft. The first mail ever carried by airplane was taken from Alameda, N. Y., to Garden City, L. I., and back with the Postmaster General of the United States as a passenger. Curtiss agents visited Europe and South America, setting planes in France, to Russia to Brazil. Then, on December 5, 1912, the United States Patent Office granted the patent application of the Aerial Experimental Association, a milestone in the nation.

The A. E. C. of America crowned a triumphant year for Curtiss by awarding to him the Robert J. Collier trophy for the most significant advance in aviation during the year, and naming him Air Pilot's License No. 1.

But Glenn Curtiss wanted an aircraft which could float, navigate the water, a flying boat. In November, 1911, he made a secret trial of such a craft, and on January 10, 1912, the flying boat flew.

Meantime the injunction which the Wrights had obtained, restraining the sale of aircraft by the Curtiss Company, had been dissolved, though the patent litigation was by no means at an end. Extension after extension was made to the motor and plane shops at Hammondsport, N. Y. The end of 1912, Curtiss' company was turning out an airplane a day.

The question now was on everybody's tongue. "Who will be the first to fly across the Atlantic?" Hudson Warramaker, merchant, sportsman and aviation enthusiast, commissioned Lt. F. C. Fort to build a bigger flying boat with a bigger hull and more powerful gear before, and arranged with Lieut. F. C. Fort of the British Navy to undertake a trans-Atlantic flight. Work on that flying boat, the *Ferris*, was begun in December, 1913. It was almost ready to fly when, in August, 1914, Germany and Great Britain went to war. Lieut. Fort was recalled for service and the *Americus* was bought by the British Government for submarine-detecting patrol duty.

IN THE meantime two honors had come to Curtiss which, among all of his aviation triumphs, he cherishes most highly. First was the award to him, in May, 1914, by the Smithsonian Institution of Washington of the Langley medal for achievement, a pound of pure gold, presented for services in the development of artificial flight, and received from the hands of his pioneer associate, Prof. Alexander Graham Bell. The other was an election by the Smithsonian Institution to prove that Prof. Samuel P. Langley, the Institution's famous secretary, had actually built a flying machine that could fly.

Curtiss took the old Langley aerodrome of 1903 from its resting place in the National Museum, and shipped it to Hammondsport. What happened then is perhaps best told by the inscription on the placard set up in front of the machine, in the Museum at Washington.

"In 1914," the inscription reads, after describing Professor Langley's ill-fated efforts to make his machine fly, "the experiments were resumed, using all available parts of the original machine. The frame and engine were the same as in the first trial; the reconstructed wings were used without the leading edge extension; the control surfaces were reconstructed and packing materials with necessary bracing were substituted for the original catapult. Thus reconstructed, and weighing over four percent more than in 1903, with Glenn H. Curtiss as the pilot, it was successfully flown at Hammondsport, N. Y., June 2, 1914. With a 20-horsepower engine and tractor propeller, it was subsequently flown repeatedly. These tests indicated that the original machine would have flown in 1903 had it been successfully launched. After the Hammondsport flights the machine was restored in accordance with the original drawings and data under the supervision of one of the original investigators, using all original parts as available. In 1918 the machine was restored and deposited in the National Museum for permanent exhibition."

IN A few short months all Europe was a war. German-made battle airplanes, single-engine, but war in the air. France and England were caught unprepared. Nowhere in the world had anybody but Glenn Curtiss ever built a machine like that. Nowhere else was there a factory equipped and ready to turn out planes and motors at high speed.

"The British Government wants you to build a plane you can as fast as you can," was the substance of the message Glenn Curtiss received through the British Embassy at Washington.

Continued on page 143

1

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5 MINUTE VULCANIZER

Here Are Correct Answers to Questions on Page 51

1. The harbor of Pago Pago on the island of Tutuila southwest of the Hawaiian Islands. The ancient volcano that forms the island sank so that the sea broke into its crater, forming the beautiful harbor now occupied as an American Naval base.

2. At the south end of Monterey Bay, California, lies the Monterey Peninsula, on which grow two remarkable species of trees—the Monterey cypress and the Monterey pine. These grow naturally nowhere else in the world. The twisted weirdly-shaped trees so often seen in pictures of Monterey belong to this strange and vanishing kind of cypress.

3. This still is a mystery. Scattered over the eastern half of the United States are roundish hills and long mounds, sometimes shaped like serpents, constructed long before the white men came to America. Scientists believe they were built by the ancestors of the American Indians.

4. Because the Bermuda Islands possess no streams. The roofs are used to collect rain water for water supply, and for sanitary reasons it is necessary that the roofs be kept clean and whitewashed. The water is stored in tanks and cisterns.

5. Because the peculiar straw out of which the best grades of Panama hats are woven, known locally as "paja toquilla," grows in Panama. The hat-making process is a rather complicated one of soaking and working the straw in addition to weaving.

6. On the River Towy, in southwestern Wales, you still can see boats constructed exactly as they were in Roman times.

7. The floating islands of the Nile are really masses of the famous papyrus plant, that supplied the Egyptians with their paper. Matted masses of the plants frequently are torn loose by the current and float as actual islands, large and strong enough to support many men.

8. They were gardens built on top of a structure of great arches, such as the arches that support modern stone bridges, because Babylon was very flat and subject to floods. Water for irrigating them was brought up by bucket pumps worked by slaves.

9. This used to be a more or less common medicine all over the world. At present, so far as is known, the common use of the monkey-ash medicine survives only in Siam, where native doctors consider the ashes a valuable remedy for consumption and other diseases of the throat and lungs. Gradually, however, modern medical knowledge is spreading into these remote countries, too.

10. Nearly two thirds of the world's supply of tin comes from the southern part of the Malay peninsula. Politically this country is under British protection and is known as the Federated Malay States.

11. In ancient Babylon more than five thousand years ago the people settled along the banks of the Tigris and Euphrates constructed a great network of irrigation canals, dikes, and storage reservoirs, by which the water of the two rivers was distributed over the plains.

12. These two rivers are branches of the Nile, south of where it divides at the city of Khartoum. The names refer to the appearance of the water. The White Nile is usually milky from fine rock dust suspended in it. The Blue Nile contains little mud and is clear and blue.

